

A TREATMENT OF ABILDGAARDIA, BULBOSTYLIS AND FIMBRISTYLIS (CYPERACEAE) FOR NORTH AMERICA¹

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Fimbristylis, *Bulbostylis*, and *Abildgaardia* of the Tribe Scirpeae (Cyperaceae) comprise approximately 300 species, primarily of warm temperate, tropical, and subtropical regions around the world. A clear majority are plants of full sunlight, humid climate and high hydroperiod soils, though many *Bulbostylis* are found on sandy substrates that are as a rule drier than those on which *Fimbristylis* succeeds. While the number of endemic species is considerable there are many species, particularly of *Fimbristylis*, that have become widespread as wetlands weeds because of their introduction either in ship's ballast or with rice into the rice growing areas of the world. It is difficult, in the case of such ubiquitous species, to ascertain their area of origin; however, in that the older rice cultivating regions of the globe are South Asian, it is reasonable to suppose that Southern Asia is at least one of the areas in which these species are native. However the case, their synonymy is impressive (Svenson, 1957, credited Clarke with stating that 400 synonyms exist for the "dichotoma" complex alone!); it is not unlikely that a world-wide revision of these three genera would do much to relieve a nomenclature already overburdened by those who feel bound to describe new species of weeds.

The most current treatment of North American *Abildgaardia*, *Bulbostylis*, and *Fimbristylis* is that of Svenson (1957), and it is both adequate and sensible. It was based primarily upon herbarium specimens, hence was probably intended to be quite conservative. Such factors as habitat, vegetative characteristics and cytology were not considered, emphasis essentially being placed upon spikelet and fruit features. These are still among the most reliable criteria for cyperaceous plants. However, since the time of that study, a good deal more evidence has come to light, both in regard to more specimens and additional criteria. The works of Kern (1955 et al.), Koyama (1961 et al.), and Gordon-Gray (1965) among others are instructive treatises regarding a new approach to a more comprehensive treatment of these plants.

My own attack has been based primarily on a field-herbarium study. However, cytological materials have been gathered from parts of the U. S. A. and Mexico; also specimens of most of the species have been successfully

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raised from seed in the greenhouse, giving me the opportunity to make prolonged observations of living plants. This kind of work was commenced in 1963 and now, after five years and many thousands of miles covered in the field, the compilative stage is reached with but slightly less trepidation on my part. While the number of taxa treated here is but slightly over 50, there are three major obstacles to a final, definitive, study. Firstly, there is the weedy character and circumglobal distribution of many of the species which adds greatly to the problem of resolving their nomenclature. Secondly, there is the problem of the fineness of the characters that sometimes delimit species within complexes. Thirdly there is the difficulty of deciding whether these species are in three genera, two genera, or actually make up but one genus. Adding further to the complexity is the fact that no one section either of *Fimbristylis* or *Bulbostylis* is itself confined to North America; therefore no one part of this particular work could itself be deemed complete. Hence, my chosen alternative is one of expedience. It is the purpose of this work hopefully to clarify circumscription of species, and to leave out most speculation as to problems of generic versus sectional rank for *Bulbostylis* and *Abildgaardia*. One is presently confronted with several nomenclatural alternatives, at a time when much field and experimental evidence yet remains to be gotten. The work of Tanaka (1939 et al.) is an indication that many Scirpoid genera (*Eleocharis*, *Scirpus*, *Fimbristylis*, *Bulbostylis*) and some genera of other tribes show a marked departure from the usual angiospermous mode of microsporogenesis. Koyama's (l.c.) work has shown the tremendous potential of studies made of floral and spikelet anatomy and morphology. Ultimately, the above sort of work, when combined with traditional morphological approaches, will lead to a better understanding of what constitutes generic characteristics in the Cyperaceae. Yet while the pilot work is hardly done the family is presently undergoing what seems to be a lot of nomenclatural upheaval. Perhaps wholesale combinations ought to be deferred until such time as the genera of Cyperaceae are better collected, hence better known at the species level. My own area of study is very well known compared to many equivalent areas of Asia or the New World and yet I am obliged in my treatment to add several new taxa. In other words, who is presently to know which species actually comprise the limits of cyperaceous genera as presently understood?

Some workers have treated *Bulbostylis* (a segregate in large part of the old, now obsolete and highly artificial genus *Isolepis* R. Br.) and *Abildgaardia* as sections of *Fimbristylis*. The former is comprised of tufted, wirey-leaved, eligulate plants, usually of sandy soils. The orifice of the leaf sheaths is, in these species, long-hairy. Spikelets are, as in *Fimbristylis*, from solitary to densely clustered or loosely cymose. Usually the style base persists as a small, button-like, tubercle, or fits cap-like over an apical projection of the akene body. All *Bulbostylis* have trifid, smooth styles and, usually, 3-angled akenes. *Abildgaardia* is, in the area of this treatment, comprised of but two species of bulbous-based, eligulate, perennials. The spikelets are

essentially distichous, though sometimes individual spikelets have torque. The akenes are stipitate-obovoid, the surfaces warty; the styles are trifid and smooth. Thus it does appear that the differences distinguishing these two genera from *Fimbristylis* or from each other are few; in fact some species of *Fimbristylis* exhibit certain of the characteristics mentioned above. However, generic differences in Cyperaceae are often few at best. Some *Scirpus* and *Eleocharis* (*Heleocharis*) have a perianth, some do not. The showy white bracts of *Dichromena* are not present in all of its species; *Psilocarya* exhibits many characteristics of *Rhynchospora*; *Fuirena* species range from having well developed perianth of two cycles of segments of which three are bladed, to some examples having no perianth, and so forth. Number of florets per spikelet ranges so widely within the tribe as to further obscure generic limits as now understood. Carpel number, a character which often delimits families of angiosperms, ranges from two to three within many sedge genera.

Therefore my own treatment essentially has followed the conservative nomenclature employed by Svenson, Clarke and Kunth, and for the following reasons:

1. Many of those workers who would merge *Abildgaardia* and *Bulbostylis* with *Fimbristylis*, still recognize the first two categories as sections, hence acknowledge that these comprise biological units. Both groups, at least as treated for North America, are therefore recognizable whatever rank they carry. I treat them still as genera in order to present the least exercises in nomenclature.

2. If consistency of treatment of cyperaceous plants is to be sought and if a philosophy similar to that back of the merger of *Bulbostylis* and *Abildgaardia* is to be followed, so many other combinations ought to be made just for North American representatives (i.e. *Eleocharis*, *Dichromena*, *Kyllinga*, *Psilocarya*, *Websteria*, etc.) that very few of the genera today recognized would appear in treatments, and these would be immensely cumbersome in terms of the large numbers of species involved. By this sort of reasoning, no "generic level" difference might be found to distinguish *Eleocharis* from *Scirpus*, *Eriophorum* from *Scirpus*, *Fimbristylis* from *Scirpus*, etc., and we would have a return to something very like the original Linnaean sense of cyperaceous genera. I do not claim to know how advisable this would be, but do think that the problem ought to be posed. I feel that the employment of what have been called genera as sections of other genera (as is true in this case) which themselves are on shaky ground if consistency is the objective, is perhaps premature.

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not only making available a large store of fine and recently collected specimens, but also for imparting to me a small part of his great knowledge of the flora of the southeastern United States; to Dr. A. Skovsted and to Dr. A. Lourteig of C and P respectively, who have provided me loans of critical type material without which my concept of many of the earlier names of *Fimbristylis* species would not have been possible; to Dr. J. Rzedowski, Instituto Politecnico, Mexico City, for his great help in directing me to critical collecting localities and thereby making my trips to Mexico far more productive than they otherwise might have been. Also, though there is no satisfactory way for me to communicate my thanks to countless good people from both north and south of the Mexican border, who provided friendly assistance along the way, these thanks are nonetheless heartfelt.

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MORPHOLOGY

Habit. *Abildgaardia*, *Bulbostylis* and *Fimbristylis* comprise both annual and perennial species. Perennation does not seem to be related to latitude; in other words, some species are not perennial in the southern part of their range, annual to the north. Material of annual species (i.e. *B. barbata*, *B. capillaris*, *F. autumnalis*, *F. miliacea*, *F. vahlii*, *F. annua*, *F. tomentosa*) grown in the greenhouse under fairly uniform temperature start to die back toward the end of summer or at the time of fruit maturation; these are true annuals. Perennial species (i.e. *B. ciliatifolia coarctata*, *B. juncooides*, *F. puberula*, *F. caroliniana*, *F. thermalis*, *F. argillicola*, etc.) also start to die back at about the time most of the fruit is mature and being shed; however these are at the same time developing overwintering buds or shoots or both. All species have an erect or ascending culm habit and leaves which tend to crowd toward the base of the culm.

Rootstock. The two species of *Abildgaardia* treated here perennate from clusters of bulbous-based culms, these developing as lateral offshoots. *Bulbostylis* species are strictly caespitose, with fibrous-diffuse root systems. Some species of *Fimbristylis* (e.g. *F. puberula*, *F. caroliniana*, *F. thermalis*) are rhizomatous. *F. caroliniana* may produce huge clones by systems of slender, elongate, shallow rhizomes. *F. puberula* var. *puberula* characteristically produces shorter, stouter rhizomes which are actually systems of coalesced bulbous plant bases. However, in the case of this latter species, character of the substratum and/or amount of ground water present may have some effect, for some *F. puberula* may produce crops of slender rhizomes in addition.

Most species of *Fimbristylis* are caespitose and arise from diffuse fibrous roots systems; bases of the perennials are often deepset and hard while those of the annuals are shallowly set. Perennials have the thickest roots.

Leaves. The leaves of *Abildgaardia* and *Bulbostylis* are usually arranged in spiral fashion toward the culm base. The leaves of *Fimbristylis* may be distichous (*F. autumnalis*, *F. miliacea*, etc.) or spirally arranged. The leaf bases in all three genera are characteristically clasping or actually form a sheath, the margins of which are quite thin, sometimes scarious. In some *Fimbristylis* a ligule of short, appressed, upwardly directed hairs is present. Neither *Abildgaardia* nor *Bulbostylis* produces a comparable structure. The apex of the leaf sheath in *Bulbostylis* is fimbriate or long-hairy in all North American species, this constituting a good generic character. Leaf blades in all three genera are of an elongate-linear type; in some species they are flat while in others they may be very inrolled. Vestiture of foliage may range from perfectly smooth, to scabrous or quite pubescent. Trichome characters are often useful in distinguishing species within species complexes.

Scapes. The scapes of *Abildgaardia*, *Bulbostylis* and *Fimbristylis* are usually rigid, erect or ascending, terete, angulate or somewhat flattened, and range from smooth to variously hairy. In such species as *B. setacea*, *B. pauciflora*, *B. funckii*, *F. complanata*, *F. autumnalis*, the morphology of the leaves and scape is too similar to escape notice. In these, the longest involucre bract often appears to be merely an extension of the scape; often an inflorescence will abort or no spikelets will form, and the scapes appear even more leaf-like.

Inflorescence. The basic type of inflorescence for all three genera is the spikelet. This is comprised of several to very many florets arranged in a spiral to subdistichous fashion on the axis, each subtended by a scale. In most *Fimbristylis* and *Bulbostylis*, the arrangement of the florets is in a distinct spiral; in *Abildgaardia* there is a tendency toward a distichous arrangement. Often the lowermost scales of a spikelet are barren, but the number of barren scales while low in all cases varies between species. The midribs of the lowermost fertile scales often are excurrent, these in the spikelet often grading above into scales with the midrib included and below into the involucre bracts which have prominent, leaflike blades. The spikelets themselves may be solitary on the scape (as is the case in *F. schoenoides*, *Abildgaardia ovata*, or *B. pubescens*) or arranged in simple or complex umbelliform arrangements of spikelets or cymules of spikelets. In species which normally have several spikelets, crowding or droughtiness may result in depauperate individuals which produce solitary spikelets. In most of the species which have branched inflorescences, the commonest arrangement is for the primary rays to arise around a central, sessile spikelet, the whole structure invested in one or more leaf-like involucre bracts. These primary rays are usually of varying length and may terminate in but a single spikelet, an involucre cluster of three spikelets with the central one sessile, or themselves may be compound. The commonest

number of spikelets within individual cymules is three. Great extremes exist within *Fimbristylis* and *Bulbostylis* ranging from considerable reduction of primary or primary and secondary rays to produce a densely glomerate, or head-like cluster (e.g. *B. warei*, *B. vestita*, *B. stenophylla*, *F. spathacea*) to a highly diffuse, highly branched system (*B. ciliatifolia* var. *coarctata*, *B. capillaris*, *B. juncooides* (extremes), *F. dichotoma*, *F. spadicea*, *F. complanata*, etc.).

Sequence of flowering on the plant is as to be expected in cymose arrangements; the central spikelets develop first, and there is progressive development outward. Sequence of flowering within the spikelet is acropetal; in each floret the gynoecium reaches anthesis before the androecium. The usual flowering pattern is for the florets of one or more of the close-set spirals of a spike to put forth stigmatic surfaces; then anthers from these same spirals will be exerted, but by this time the stigmatic areas have already turned brown; then stigmatic surfaces will protrude from the next set of spirals above, and so forth. The inflorescence is indeterminate, hence the total length of an older spikelet will show, from apex to base, a growing tip, a series of spirals of immature florets, some spirals either putting out stigmas or anthers, some spirals with fruit in various stages of development, and finally a basal portion of rachis from which the scales and akenes have fallen. In all cases the flowering pattern is for all florets of one or two (or more) spirals in a given spikelet to put forth anthers or stigmatic surfaces; it is never the case that both sexes are in anthesis at the same time in a given spikelet. Usually the entire plant is either receiving or sending pollen. Hence there appear to be few opportunities for pollen from one plant to reach stigmatic surfaces of that plant; out-crossing appears to be the rule.

Flowers. The flower of *Abildgaardia*, *Bulbostylis*, and *Fimbristylis* lacks a perianth. It is short-pedicellate, and this "joint" is itself subtended by a scale which conceals all but the exerted style tips and anthers. Stamen number varies somewhat within species, but is within the range of from one to three, uncommonly four. Annual species tend to have lower numbers, often only one, while the perennials tend to have three per flower. The anthers are short or long linear or oblong, basifixed, and in some species with the apices of the thecae plus elements of the connective prolonged into a narrowed and sterile apex. The two thecae on either side of the connective release their pollen at its maturity by means of a single lateral and longitudinal slit. The gynoecium is made up of two or three carpels; the three-carpellate types have, as a rule, trigonous fruit while the two-carpellate types produce lenticular or columnar fruit. In *Fimbristylis* the style is early trichomiferous.

Fruit. The fruit in all three genera is a trigonous, cylindrical or lenticular akene whose sculpturing is usually specific. In *Bulbostylis* the style base is usually persistent at the summit of the akene; in *Abildgaardia* and *Fimbristylis* it is deciduous. In *Abildgaardia*, the surface of the fruit is finely reti-

culate, the reticulum being made up of roughly isodiametric to horizontally oriented rectangular cells and in addition is usually coarsely verrucose; in *Bulbostylis* the pericarp is usually made up of rows of vertical, narrowly rectangular to almost linear cells, less commonly of isodiametric cells, the whole surface either rugose or papillose or both; in *Fimbristylis* the pericarp is usually reticulate, the reticule usually made up of horizontally oriented rectangular cells or of isodiametric cells, in either case appearing to be arranged in vertical rows, and sometimes verrucose as well.

CYTOLOGY

As has been commented on by Tanaka (1939, 1941), the mode of microsporogenesis in *Fimbristylis* and *Bulbostylis* is unusual. In my own observations of this phenomenon, the nucleus of the microspore mother cell meiotically divides, then divides mitotically in traditional fashion. However, cytokinesis does not take place. Sutures form in the mother cell wall, but no complete wall formation occurs. Instead, three of the tetrad of haploid nuclei retire to one end of the microsporocyte (at this stage the cell outline is obovoid) and lose both size and distinctness. At the same time the fourth nucleus again divides mitotically. Of these two products, one loses size and joins the other three reduced nuclei. The remaining, or fifth, nucleus is that which later will give rise to pollen tube and sperm. At the time of the third division, the wall of the microspore mother cell thickens and internal detail is gradually lost as the characteristic, pebbled, sculpturing of the exine takes place (see illustrations of the various stages).

In short, the entire process of microsporogenesis takes place within the microspore mother cell wall, which itself becomes the covering of the single pollen grain produced in the process. I have observed this in *Fimbristylis*, *Abildgaardia* and *Bulbostylis* and assume therefore that it is at least a widespread phenomenon in the three genera. I have seen it also in eight species of *Fuirena* (*F. pumila*, *F. squarrosa*, *F. simplex*, *F. longa*, *F. scirpoidea*, *F. breviseta*, *F. umbellata*, and one undetermined species); this will be reported on in a later paper. All of these genera are members of the Scirpeae. It is interesting that, in the case of such sedges, microsporogenesis is somewhat similar to megasporogenesis in some other plants.

CHROMOSOME COUNTS IN ABILDGAARDIA, BULBOSTYLIS, FIMBRISTYLIS

Several chromosome counts have been made of Fimbristyloid sedges prior to my own efforts. A check of the Chromosome Atlas (Darlington and Wylie, ed. 2, 1955, plus supplements) reveals the following:

1. *Abildgaardia monostachya* (equals *A. ovata*), 2N equals 20 (Sharma and Bal, 1956).
2. *Bulbostylis barbata*, N equals 5 (Tanaka, 1939).
3. *Bulbostylis capillaris* var. *trifida*, 2N equals 84 (Tanaka, 1937).
4. *Fimbristylis aestivalis*, 2N equals 10 (Sharma and Bal 1956); N equals

- 5 (Chuang et al, 1963).
5. *Fimbristylis autumnalis*, N equals 5, 2N equals 10 (Tanaka 1937).
 6. *Fimbristylis complanata*, 2N equals 16 (Tanaka, 1939).
 7. *Fimbristylis complanata*, N equals 5 (Sharma, 1962).
 8. *Fimbristylis cymosa*, N equals 28, 2N equals 48 (Skottsberg, 1955).
 9. *Fimbristylis dichotoma* (probably *F. tomentosa*), 2N equals 10 (Sharma and Bal, 1956).
 10. *Fimbristylis dichotoma* (probably *F. tomentosa*), N equals 5 (Sharma, 1962).
 11. *Fimbristylis diphylla* (probably *F. dichotoma*), 2N equals 20 (Sharma and Bal, 1956).
 12. *Fimbristylis diphyloides* (equals *F. tristachya*), 2N equals 10 (Tanaka, 1939).
 13. *Fimbristylis makinoana*, 2N equals 24 (Tanaka, 1939).
 14. *Fimbristylis miliacea*, 2N equals 10 (Tanaka, 1939).
 15. *Fimbristylis miliacea*, 2N equals 10 (Gadella and Klip., 1964).
 16. *Fimbristylis miliacea*, N equals 5 (Chuang et al, 1963).
 17. *Fimbristylis quinquangularis*, N equals 5 (Dnyansagar and Tiwari, 1956).
 18. *Fimbristylis sericea*, 2N equals 44 (Tanaka, 1939).
 19. *Fimbristylis squarrosa*, 2N equals 20 (Tanaka, 1939).
 20. *Fimbristylis subbispicata*, 2N equals 10 (Tanaka, 1939).

My technique for making aceto-carminic smears permanent has been that described by Beeks (1955), which involves Hoyer's Solution. The handling of root tips was based on the double-staining method of Snow (1963). I have had some difficulty with the Beeks technique, some material not holding up more than a few days and other material being still good after four years. Chromosome counts are summarized below:

Abildgaardia mexicana (N10); *A. ovata* (N10); *Bulbostylis barbata* (N5); *B. pubescens* (N5, 10); *B. funckii* (N10); *B. stenophylla* (N15); *B. hirta* (N15); *B. warei* (N15); *B. trilobata* (N25); *B. ciliatifolia* var. *coarctata* (N30); *B. junciformis* (N30); *B. vestita* (N30); *B. juncoides* (N60); *Fimbristylis autumnalis* (N5, 2N10); *F. complanata* (N5); *F. miliacea* (N5); *F. schoenoides* (N5); *F. tomentosa* (N5); *F. perpusilla* (N5); *F. vahlii* (N10); *F. thermalis* (N10); *F. spadicea* (N10); *F. pallidula* (N10); *F. castanea* (N10); *F. argillicola* (N10); *F. decipiens* (N10); *F. annua* (N15); *F. dichotoma* (N10, 15); *F. puberula* var. *interior* (N10); *F. puberula* var. *puberula* (N10, 20); *F. caroliniana* (N10, 20, 30); *F. spathacea* (N24).

A polyploid series from the base number of 5 appears to be the case in most of the North American examples; the only exception is *F. spathacea*, which appears to have arisen from another series whose base number could be either 6 or 8.

In *F. dichotoma*, *F. puberula* and *F. caroliniana* two or more chromosome complements exist within species. In the case of *F. dichotoma*, the haploid number of 10 appears to correlate in most cases with a denser inflorescence,

but this external character difference breaks down in Mexico. In the case of *F. puberula* var. *puberula*, the haploid complement of 10 is far more frequent than 20. In the case of *F. caroliniana*, the haploid complement of 30 may be associated with a taller, more robust, exclusively coastal form; the count of 20 is morphologically intermediate in its external form to individuals whose complement is 10. These latter may be rhizomatous forms of *F. puberula* or actual hybrids between the two species. This remains to be determined; certainly at this stage of the study I am at a loss as how to annotate such examples.

A list of specimens which serve as vouchers for my work is below:

1. *Abildgaardia mexicana* (Palla) Kral. Anther smears: N equals 10. MEXICO. DISTRITO FEDERAL.: *Kral* 27694; MEXICO.: *Kral* 25487. MICHOACAN.: *Kral* 25520; *Kral* 25569; *Kral* 25580; *Kral* 27685; *Kral* 27691.
2. *Abildgaardia ovata* (Burm. f.) Kral. Anther smears: N equals 10. MEXICO. CHIAPAS.: *Kral* 27767. U.S.A. FLORIDA. MONROE CO.: *Kral* 18128.
3. *Bulbostylis barbata* (Rottb.) Clarke. anther smears: N equals 5. U.S.A. GEORGIA. BAKER CO.: *Kral* 28602; LIBERTY CO.: *Kral* 18826. SOUTH CAROLINA. BAMBERG CO.: *Kral* 27155.
4. *Bulbostylis ciliatifolia* (Ell.) Fern. var. *coarctata* (Ell.) Kral. Anther smears: N equals 30. U.S.A. FLORIDA. OKALOOSA CO.: *Kral* 27691. NORTH CAROLINA. BLADEN CO.: *Kral* 27187.
5. *Bulbostylis funckii* (Steud.) Clarke. Anther smears: N equals 10. MEXICO. JALISCO: *Kral* 27643.
6. *Bulbostylis hirta* (Thunb.) Svenson. Anther smears: N equals 15. MEXICO. NAYARIT: *Kral* 27553; *Kral* 27540.
7. *Bulbostylis junciformis* (HBK.) Lindm. Anther smears: N equals 30. MEXICO. OAXACA: *Kral* 27778. VERACRUZ: *Kral* 27796.
8. *Bulbostylis juncooides* (Vahl.) Kukenth. Anther smears: N equals 60. MEXICO. NAYARIT: *Kral* 27560. PUEBLA: *Kral* 27696. JALISCO: *Kral* 27637.
9. *Bulbostylis pubescens* (Presl.) Svenson. Anther smears; N equals 5. MEXICO. NAYARIT: *Kral* 27504; *Kral* 27509. OAXACA: *Kral* 27739. N equals 10. MEXICO. OAXACA: *Kral* 27738.
10. *Bulbostylis stenophylla* (Ell.) Clarke. Anther smears: N equals 15. U.S.A. FLORIDA. TAYLOR CO.: *Kral* 23039; WALTON CO.: *Kral* 19372. GEORGIA. LIBERTY CO.: *Kral* 18828. NORTH CAROLINA. PENDER CO.: *KRAL* 22506.
11. *Bulbostylis trilobata* Kral. Anther smears: N equals 25 MEXICO. OAXACA: *Kral* 25329; *Kral* 27733.
12. *Bulbostylis vestita* (Kunth) Clarke. Anther smears: N equals 30. MEXICO. OAXACA. *Kral* 27783.
13. *Bulbostylis warei* (Torr.) Clarke. Anther smears: N equals 15. U.S.A. FLORIDA. CLAY CO.: *Kral* 22762; OKALOOSA CO.: *Kral* 17692; *Kral*

- 23180; SANTA ROSA CO.: *Kral* 23174; ST. LUCIE CO.: *KRAL* 22685; WAKULLA CO.; *Kral* 23021. GEORGIA. BEN HILL CO.: *Kral* 28751; BULLOCH CO.: *Kral* 22378; TATNALL CO.: *Kral* 22308; WAYNE CO.: *Kral* 22814; WHEELER CO.: *Kral* 22335.
14. *Fimbristylis annua* (All.) R. and S. Anther smears: N equals 15. MEXICO. CHIAPAS: *Kral* 27753. JALISCO: *Kral* 27616; *Kral* 27634. OAXACA: *Kral* 27741. U.S.A. ALABAMA. CRENSHAW CO.: *Kral* 22002. GEORGIA. BULLOCH CO.: *Kral* 22382; CAMDEN CO.: *Kral* 18630; CHATHAM CO.: *Kral* 18943. LOUISIANA. BEAUREGARD PAR.: *Kral* 20799. PENNSYLVANIA. CHESTER CO.: *Kray* 22601. SOUTH CAROLINA. BERKELEY CO.: *Kral* 19149.
15. *Fimbristylis argillicola* *Kral*. Anther smears: N equals 10. MEXICO. DURANGO: *Kral* 27447. JALISCO: *Kral* 27631. MICHOACAN: *Kral* 25509; *Kral* 25515; *Kral* 25521; *Kral* 27684.
16. *Fimbristylis autumnalis* (L.) R. and S. Anther smears: N equals 5. GEORGIA. BAKER CO.: *Kral* 27068. LOUISIANA. BEAUREGARD PAR.: *Kral* 20798. Root tips: 2N equals 10. MISSISSIPPI. HANCOCK CO.: e. side Kiln, 5 Jul. 1963, *Kral*.
17. *Fimbristylis caroliniana* (Lam.) Fern Anther smears: N equals 30. MEXICO. TAMAULIPAS: *Kral* 25012; *Kral* 27813. VERACRUZ: *Kral* 27806; *Kral* 27809. U.S.A. ALABAMA. BALDWIN CO.: *Kral* 23145. DELAWARE. SUSSEX CO.: *Kral* 22552. FLORIDA. BAY CO.: *Kral* 19285; CHARLOTTE CO.: *Kral* 22920; LEVY CO.: *Kral* 22944; NASSAU CO.: *Kral* 18614; PASCO CO.: *Kral* 22957; ST. LUCIE CO.: *Kral* 22868. GEORGIA. GLYNN CO.: *Kral* 18657. NORTH CAROLINA. DARE CO.: *Kral* 22531; ONSLOW CO.: *Kral* 22469. SOUTH CAROLINA. GEORGETOWN CO.: *Kral* 19016. HORRY CO.: *Kral* 19014. TEXAS. KENEDY CO.: *Kral* 27352. VIRGINIA. ACCOMAC CO.: *Kral* 22558. Root tips: N equals 60. MISSISSIPPI. HARRISON CO.: *Kral* 17559. Anther smears: N equals 20. FLORIDA. BREVARD CO.: *Kral* 18400; LEE CO.: *Kral* 18002; OKEECHOBEE CO.: *Kral* 22090. GEORGIA. BAKER CO.: *Kral* 20490. Anther smears: N equals 10 (Possible influence of *F. puberula* here thus plants perhaps better treated as either *F. puberula* or hybrid; most of these examples look like rhizomatous *F. puberula* var. *puberula*). FLORIDA. CHARLOTTE CO.: *Kral* 22920; PASCO CO.: *Kral* 22963; ST LUCIE CO.: *Kral* 18369; *Kral* 22861.
18. *Fimbristylis castanea* (Michx.) Vahl. Anther smear: N equals 10. U.S.A. FLORIDA. BREVARD CO.: *Kral* 18398; GULF CO.: *Kral* 19291; MARION CO.: Glen Silver Springs, a *Godfrey* collection reared in greenhouse; NASSAU CO.: *Kral* 18613; VOLUSIA CO.: *Kral* 18480. GEORGIA. GLYNN Co.: *Kral* 18656. MISSISSIPPI. HARRISON CO.: *Kral* 17560. NORTH CAROLINA. BRUNSWICK CO.: *Kral* 18985; ONSLOW CO.: *Kral* 22470; SOUTH CAROLINA. BEAUFORT CO.: *Kral* 18896; *Kral* 22686; GEORGETOWN CO.: *Kral* 19017. TEXAS. GALVESTON CO.: *Kral* 20806; JEFFERSON CO.: *Kral* 20814; MATAGORDA CO.: *Kral* 20108; SAN PA-

- TRICO CO.: *Kral* 21159. VIRGINIA. ACCOMAC CO.: *Kral* 22559. Root tips: 2N equals 20. FLORIDA. BAY CO.: *Kral* 17768. MISSISSIPPI. HARRISON CO.: *Kral* 17560.
19. *Fimbristylis complanata* (Retz.) Vahl. Anther smears: N equals 5. MEXICO. JALISCO: *Kral* 27587. NAYARIT: *Kral* 27561. PUEBLA: *Kral* 27705. VERACRUZ: *Kral* 25456.
 20. *Fimbristylis decipiens* Kral. Anther smears: N equals 10. U.S.A. GEORGIA. COFFEE CO.: *Kral* 22247-48; WAYNE CO.: *Kral* 22710. LOUISIANA. EAST BATON ROUGE PAR.: *Kral* 27346; LIVINGSTON PAR.: *Kral* 27852; WASHINGTON PAR.: *Kral* 19381.
 21. *Fimbristylis dichotoma* (L.) Vahl. Anther smears: N equals 15. FLORIDA. BREVARD CO.: *Kral* 18386. GEORGIA. WORTH CO.: *Kral* 22120. LOUISIANA. BEAUREGARD PAR.: *Kral* 20801; EAST BATON ROUGE PAR.: *Kral* 27845; LIVINGSTON PAR.: *Kral* 27854. Anther smears: N equals 10. MEXICO. OAXACA: *Kral* 27785. VERACRUZ: *Kral* 27794. U.S.A. ALABAMA. BALDWIN CO.: *Kral* 23144. FLORIDA. BAY CO.: *Kral* 23202; DUVAL CO.: *Kral* 18594; OSCEOLA CO.: *Kral* 22820; VOLUSIA CO.: *Kral* 18452. GEORGIA. COLQUITT CO.: *Kral* 22090. LOUISIANA. JEFFERSON DAVIS PAR.: *Kral* 27832; ST. TAMMANY PAR.: *Kral* 23065.
 22. *Fimbristylis miliacea* (L.) Vahl. Anther smears: N equals 5. FLORIDA. LIBERTY CO.: *Kral* 19320. LOUISIANA. LINCOLN PAR.: *Kral* 19396; WASHINGTON PAR.: *Kral* 19380.
 23. *Fimbristylis pallidula* Kral. Anther smears: N equals 10. MEXICO. OAXACA: *Kral* 25318; *Kral* 27724. SINALOA: *Kral* 25681; *Kral* 27495; *Kral* 27500; *Kral* 27501.
 24. *Fimbristylis perpusilla* Harper. Anther smears: N equals 5 (*Godfrey* 63204; *Kral* 15486, from SEMINOLE CO., GEORGIA serve as vouchers from same locality).
 25. *Fimbristylis puberula* (Michx.) Vahl var. *puberula*. Anther smears: N equals 10. ALABAMA. WASHINGTON CO.: *Kral* 27471. FLORIDA. BAY CO.: *Kral* 17770; BREVARD CO.: *Kral* 18419; ST. LUCIE CO.: *Kral* 18329; SARASOTA CO.: *Kral* 17912; TAYLOR CO.: *Kral* 23041; WALTON CO.: *Kral* 19374. GEORGIA. BAKER CO.: *Kral* 20488; *Kral* 27066; COLQUITT CO.: *Kral* 22089. LOUISIANA. BEAUREGARD PAR.: *Kral* 20173; LA SALLE PAR.: *Kral* 20106; RAPIDES PAR.: *Kral* 20155; VERNON PAR.: *Kral* 16803. TENNESSEE. COFFEE CO.: *Kral* 26872. Anther smears: N equals 20. GEORGIA. COFFEE CO.: *Kral* 27107; EVANS CO.: *Kral* 27166.
 26. *Fimbristylis puberula* (Michx.) Vahl. var. *interior* (Britton) Kral. Anther smears: N equals 10. NEBRASKA. DAWSON CO.: *Kral* 28923; HOWARD CO.: *Kral* 28872; KEARNEY CO.: *Kral* 28927; SHERMAN CO.: *Kral* 28963.
 27. *Fimbristylis schoenoides* (Retz.) Vahl. Anther smears: N equals 5. ALABAMA. BALDWIN CO.: *Kral* 23142. FLORIDA. DUVAL CO.: *Kral*

- 18593; LEE CO.: *Kral* 22929; WAKULLA CO.: *Kral* 23025; WALTON CO.: *Kral* 19365; GEORGIA. CAMDEN CO.: *Kral* 18616; WAYNE CO.: *Kral* 19260. Root tips: 2N equals 10. MISSISSIPPI. HANCOCK CO.: *Kral* 17569.
28. *Fimbristylis spadicea* (L.) Vahl. Anther smears: N equals 10. MEXICO. TAMAULIPAS. *Kral* 24993; VERACRUZ: *Kral* 27805.
29. *Fimbristylis spathacea* Roth. Anther smears: N equals 24. FLORIDA. MARTIN CO.: (from greenhouse plants grown from seed taken from n. of Stuart, Fla., during winter of 1963).
30. *Fimbristylis thermalis* S. Watson. Anther smears: N equals 10. MEXICO. COAHUILA: *Kral* 25771. U.S.A. CALIFORNIA. INYO CO.: *Kral* 21784; SAN BERNARDINO CO.: *Kral* 21591.
31. *Fimbristylis tomentosa* Vahl. Anther smears: N equals 5. ALABAMA. BALDWIN CO.: *Kral* 23143. GEORGIA. CHATHAM CO.: *Kral* 18937; COLQUITT CO.: *Kral* 22091; WAYNE CO.: *Kral* 19259. LOUISIANA. BEAUREGARD PAR.: *Kral* 20802; LAFAYETTE PAR.: *Kral* 27838; LIVINGSTON PAR.: *Kral* 27853; NATCHITOCHE PAR.: *Kral* 20692; LINCOLN PAR.: *Kral* 19397; WASHINGTON PAR.: *Kral* 19382. SOUTH CAROLINA. BERKELEY CO.: *Kral* 19211. Root tips: 2N equals 10. MISSISSIPPI. HANCOCK CO.: *Kral* 17568; STONE CO.: *Kral* 17402.
32. *Fimbristylis vahlii* (Lam.) Link. Anther smears: N equals 10. LOUISIANA. CLAIBORNE PAR.: *Kral* 19431; LINCOLN PAR.: *Kral* 15910; UNION PAR.: *Kral* 23228. TEXAS. WALKER CO.: *Kral* 29018.

TAXONOMIC TREATMENT

In the treatment which follows, keys and descriptions are based on material collected from within the area of study, namely North America. Generic limits are drawn only in the sense of North American species of these genera. Keys are based upon healthy, not depauperate, material. Dimensions of leaves are drawn from the fully expanded, longest leaves of a specimen. Dimensions of spikelets are drawn only from the scale-bearing portion of the spikelet (older spikelets often have a very large portion of rachis from which the scales have fallen, and this is not included in the measurement). Descriptions of fertile scales are based upon mature scales that subtend well developed akenes. Descriptions of akenes, particularly akene colours and surfaces, are drawn strictly from ripe akenes.

Species are numbered in a single continuous sequence for all three genera.

KEY TO FIMBRISTYLIS AND ALLIED GENERA

1. Tubercle of akene usually persistent; summit of leaf sheath long-ciliate or fimbriate; akene of most species trigonous; style three-branched, smooth save for papillosity of branches, its base usually 3-angled; surfaces of akene reticulate or cancellate or colliculate, often in addition transversely rugose; cells of surface usually very narrow and vertically ar-

- ranged, or produced outward into papillae; tufted, filiform-leaved, annuals or perennials of moist to dry, usually sandy sites . . . *Bulbostylis*, p. 73
1. Tubercle of akene deciduous; summit of leaf sheath short-ciliate or entire; akene trigonous, obovoid, lenticular or columnar; style 2 or 3-branched, usually long-papillate or fimbriate, flattened or cylindrical, or 3-angled; surfaces of akene reticulate (sometimes very obscurely so), with the cells usually transversely elongate, isodiametric, sometimes raised as warts or concave as shallow pits; tufted or rhizomatous, usually linear-leaved, annuals or perennials of a variety of habitats.
 2. Spikelet usually flattened, the scales distichous, or subdistichous; base of style abruptly thickened, trigonous; akene obovoid, prominently stipitate, verrucose with numerous large, smooth, dome-like projections; bulbous-based, caespitose perennials, the spikelets usually either solitary or several in a single terminal cluster . . . I. *Abildgaardia*, p. 70
 2. Spikelet with scales spirally arranged, usually not keeled; style base flattened or dilated, sometimes thickened but usually not trigonous; akene trigonous or lenticular or columnar, reticulate or finely pitted and sometimes also verrucose, akene base not prominently stipitate; caespitose or rhizomatous annuals or perennials, the inflorescences various.

. III. *Fimbristylis*, p. 100

I. ABILDGAARDIA Vahl, Enum. 2: 296. 1805.

Perennial, smooth, the culms tufted, usually bulbous-based, spreading, leafy toward the base. Leaves narrowly linear to filiform, thickened, flat or involute, eligulate, the sheaths closed save at the summit. Spikelets ovate, usually somewhat flattened and subdistichous, either solitary and terminal on the scapes or few to several in a dense terminal cluster or rarely in a simple dichasium of three spikelets, in any case subtended by a single bract. Fertile scales in two rows or at least subdistichous, keeled, smoothish, deciduous, the lowermost fertile, the uppermost often subtending only male florets. Florets perfect or unisexual, produced on a short pedicel joint; perianth absent. Stamens, two or three, the anthers basifixed, narrowly oblong, the two thecae at maturity longitudinally and laterally dehiscent. Style three-branched, the unbranched portion smooth, three-angled, expanded at the base, the style base deciduous from the akene. Akene stipitate, obscurely trigonous to subglobose, apiculate, verrucose.

About 15 species of New and Old World tropics.

Type species: *A. monostachya* (*A. ovata*).

KEY TO NORTH AMERICAN ABILDGAARDIA

1. Spikelets reddish-brown, sometimes solitary at the apices of culms, more often sessile in small clusters at the apices of culms; plants of the Mexican high plateau, usually abundant on heavy soils of prairies or savannas 1. *A. mexicana* (Palla) Kral.
1. Spikelets pale, frequently solitary at the apices of culms or two or three

per culm, in which case scattered toward the culm tip; plants primarily of lower elevations in Mexico, in the southern tip of Florida (on limerock), and in various habitats in the Caribbean Islands.

. 2. *A. ovata* (Burm. f.) Kral.
1. **ABILDGAARDIA mexicana** (Palla) Kral, comb. nov.

Fimbristylis crassipes Boeckl., *Linnaea* 38: 392. 1874, not *F. crassipes* Boeckl., *Flora* 41: 602. 1858.

Fimbristylis mexicana Palla, *Oest. Bot. Zeit.* 58: 390-391. 1908.

Tufted perennial, the culms bulbous-based, usually spreading in a rosette fashion, and up to 4 dm. long, the outer leaves of a culm usually scape-like. Leaves usually half the length of the culms, the blades linear-filiform, seldom wider than 1 mm., smooth, flat, very firm, thickened, often somewhat involute, the backs prominently ribbed and with two ribs making a thickened-cartilaginous, ciliate-scabrid margin; sheaths broad, thick, clasping, pale tan to dark brown, sharply converging into the blade. Scape slender, about the width of the leaf blades, many-ribbed, subterete, smooth. Longest bract of the inflorescence shorter than the inflorescence, the margin of the blade similar to the leaves. Spikelets lance-ovoid, acute, ca. 1.0-1.5 cm. long, with few fertile scales, quite flat when young, rarely solitary, more usually in terminal clusters of from 2 to 5, at maturity quite thickened by the mature fruit. Fertile scales ovate, acute, smooth, subentire, a rich reddish-brown, curvate-keeled, subscarious save for a prominent greenish or tan midrib, this excurrent as a short, sometimes slightly reflexed mucro. Stamens 2 or 3, the anthers 2.0-2.3 mm. long. Style 3-branched, smooth, trigonous at the base. Akenes 2-3 mm. long, stipitate-obovoid, the apex apiculate or truncate, the surface pale brown to white, pebbled.

Moist to wet heavy dark clay earths of the grasslands of the Mexican high plateau in the states of Aguascalientes, Durango, Guanajuato, Guerrero, Distrito Federal, Jalisco, Mexico, Michoacan, Puebla, Queretaro, San Luis, Potosi, and Zacatecas.

Type locality: "Mexique . . . Santa Barbara pres Puebla, 25 Jun 1909, G. Nicolas." Isotype at NY examined.

A. mexicana is very similar to *A. ovata*, differing from it only by its harsher leaf margins, the darker tones of its spikelets, and the tendency for the spikelets to form terminal clusters (*A. ovata* has straw coloured spikelets which are either solitary or few and separated along the axis, or rarely in terminal cymules of three, with the laterals pedicellate).

In Mexico, the only country in which both species occur, *A. mexicana* is found in one of the most beautiful regions of the world, the moist, cool grasslands of the Mexican high plateau, where its reddish-brown spikelets form part of a harmonious tapestry of grass, sedge, sunflower, *Eryngium*, *Cuphea* and *Lobelia*. Heavy grazing and consequent erosion have much reduced its numbers. *A. ovata* on the other hand appears to occupy only the lower elevations in Mexico and so far as I now know there are no instances of the two mingling on the same site.

As the statement of synonym indicates, Boeckler was first to describe the species but had himself published an earlier homonym.

2. **ABILDGAARDIA ovata** (Burm. f.) Kral, comb. nov.

Carex ovata Burm. f., Fl. Ind. 194. 1768.

Cyperus monostachyos L., Mant. 180. 1771.

Abildgaardia monostachya (L.) Vahl, Enum. 2: 296. 1805.

Fimbristylis monostachya (L.) Hassk., Pl. Jav. Rar. 61. 1848.

Iriha monostachya (L.) O. Kuntze, Rev. Gen. Pl. 2: 751. 1891.

Fimbristylis ovata (Burm. f.) Kern, Blumea 15: 126. 1967.

Solitary or tufted, bulbous-based, perennial to 7 dm. tall (usually much lower and with culms often spreading in tridiate fashion), the outer leaves often scale-like. Leaves usually about 1/2 the length of well developed scapes, the blades seldom wider than 1 mm., linear-filiform, smooth, flat, very firm, often slightly involute, the backs prominently ribbed and with two ribs making an incrassate margin; sheath broad, sometimes thick, clasping, pale tan or brown, tapering abruptly to the blade. Scape slender (about the width of the leaves), many-ribbed, subterete, smooth. Lowest bract of the inflorescence with short sheath and blade, its blade margin often short-ciliate or scabrid, always shorter than the inflorescence. Spikelets lance-ovoid, acute, ca. 1.0-1.5 cm. long, quite flat when young, as a rule solitary at the tip of the scapes (rarely in a simple cyme of 3 spikelets) or 2 spikelets rather well separated toward the scape tip. Fertile scales ovate, acute, smooth, subentire, usually pale yellow-green or stramineous, curvate-keeled, subscarios save for a prominent greenish or darker coloured midrib of nerves, this excurrent as a short cusp. Stamens 1-3, the anthers 3-4 mm. long. Style 3-branched, smooth, trigonous at the base. Akenes stipitate-obovoid, ca. 2.5 to nearly 3.0 mm. long, sometimes obscurely trigonous but more usually subglobose above the stipe, the whole surface pebbly.

Savannas, primarily over calcareous rock, both Old and New World tropics. In North America found in southern Florida, the Caribbean Islands, and the coastal plain or lower mountain slopes of Mexico.

Type locality: Java (see Kern, l.c.).

This species interestingly combines a vast geographic range with a remarkably uniform morphology. In the United States (Florida) and Mexico it grows in humid savanna, and forms large tufts of bulbous-based plants. The flavescent spikelets are often solitary on the scapes, but may be in twos or threes. As a rule, if there is more than one spikelet borne on the scape these are arranged in a lineal fashion; rarely the system is a simple dichotomy of three spikelets, the central sessile. Fruit appears to develop only from the lower florets of a spike, and this might constitute a generic difference.

In Florida *A. ovata* appears confined to highly calcareous substrates, particularly to solution pockets in the Miami Oolite of the southern tip of the peninsula and of the keys. Interestingly enough, the only outlying locality

for the species in the U. S. is on the "Orange Island" (Citrus County, *Kral* 7890) where it is occasional on savanna over outcrops of the Tampa limestone formation.

A. ovata forms a species pair with *A. mexicana*, a plant confined to the grasslands of the Mexican high plateau. In fruit, habit and foliage the two appear to be almost identical. However, the spikelets of *A. mexicana* are reddish, not flavescent, and are borne in clusters at the tip of the scape. The haploid chromosome complement of both species is 10.

II. BULBOSTYLIS, Kunth, Enum. Pl. 2: 205. 1837. (Sub *Isolepis*, R. Br, 1810.)

Nomen conservandum.

Neither *Bulbostylis* Steven, 1817, nor DC. 1836, nom. rejic.

Stenophyllus Raf., Neog. 4: 1825.

Oncostylis Mart.; Nees in Mart., Fl. Bras. 2¹: 80. 1842.

Perennial or annual, the culms solitary but usually in tufts, rigid or lax, usually wiry. Leaves filiform to narrowly linear, ascending to recurved, usually basal, usually scabrid, often pubescent, the sheaths long-ciliate or fimbriate apically. Spikelets lanceolate, oblong or ovoid in outline, terete to sometimes flattened or angled, solitary at the scape tips or in simple or compound umbelliform systems involving pedunculate spikelets or pedunculate cymes of spikelets, or in dense, head-like clusters, the whole inflorescence usually subtended by one or more leaf-like involucre bracts. Fertile scales glabrous or pubescent, subdistichous to more often spirally arranged, deciduous, all but the lowest (sometimes even the lowest) fertile. Florets perfect; perianth absent (the flower usually produced on a short pedicel point). Stamens one to three, the anthers oblong, basifixed, the two thecae at maturity longitudinally and laterally dehiscent, in some species the anther connective prolonged beyond the anthers into a subulate tip. Style 3-branched, the unbranched portion smooth, terete or three angled, the style branched papillate, the style base usually persisting on the akene. Akene trigonous, rarely plano-convex, often the akene face nearest the spikelet axis broader than the other two, subequal faces; surface of akene smoothish, cancellate or transversely rugose, usually made up of vertically oriented, broadly or narrowly rectangular cells, (rarely almost isodiametric cells), these either concave or produced outward into papillae.

At least 80 species, primarily on dry sandy situations in the warm-temperate or tropical regions of the world.

Type species: *B. capillaris* (L.) C. B. Clarke (by Code designation).

KEY TO BULBOSTYLIS OF NORTH AMERICA³

1. The plant with a stout, woody base, this invested by a stubble of old sheaths and old leaf bases (often the whole structure up to 3 or 4 cm. thick, usually blackened by fire); mature spikelets solitary at the culm tips, ca. 1 cm. long, pale; abundant in burned over grasslands, savannas,

³ Species numbered 3-26.

- pinelands of Cuba, Mexico (Oaxaca), Panama, and northern South America. 3. *B. paradoxa* (Spreng.) Lindm.
1. The plant not as above.
 2. Spikelets sessile, clustered in tight or open systems of fascicles or glomerules, or terminal and subcapitate, or paired and conjugate at culm tips, neither solitary nor in umbelliform cymes.
 3. Clusters of spikelets two to several per scape; Caribbean Islands, Mexico, and southward.
 4. Culms and foliage finely and copiously pubescent, texturally rough; scales of the spikelets uniformly puberulent; akene stramineous to dark brown, very delicately transversely rugose, the ridges comprised of vertically oriented cells; plants forming large, recurved-leaved, tufts. 4. *B. vestita* (Kunth) Clarke.
 4. Culms and foliage smooth; scales of spikelets not uniformly puberulent, often glabrous; ripe akene brown, white or waxy-gray, either with fine, honeycomb reticulation or pebbled with fine papillae, but definitely not rugose; plants in smaller tufts, usually taller, the culm bases often thickened, the sheaths a lustrous brown or cinnamon, the leaf blades usually ascending. 5. *B. junciformis* (H.B.K.) Lindm.
 3. Clusters of spikelets solitary at scape tips.
 5. The plants coarse, tall (usually not less than 2 dm.), tufted, perennial.
 6. Surfaces of akenes transversely rugose or smooth.
 7. Spikelets ovate, somewhat flattened, in dense, terminal, involucrate clusters, the lower margins of the involucre bracts fimbriate-pectinate, the akenes prominently 3-lobed, pale: plants of sandhills of the Coastal Plain of the southeastern U.S.A. 6. *B. warei* (Torr.) Clarke.
 7. Spikelets elongate usually linear-lanceolate or oblong in outline; margins of bracts not fimbriate; akenes not prominently 3-lobed; species from south of the U.S.A.
 8. Surfaces of leaves and scapes pubescent with spreading hairs. 4. *B. vestita* (Kunth) Clarke.
 8. Surfaces of leaves and scapes not as above.
 9. Apex of scales of spikelet usually rounded or obtuse, sometimes acute, the scale margins pectinate-lacerate or fimbriate; akene dark brown or blackish, appearing smooth and lustrous; spikelets often crowded at plant base as well as being on culm tips; culm seemingly continuous with the primary bract of inflorescence, hence inflorescence appearing lateral; plants of beaches of Bahamas, Cuba, Hispaniola. 7. *B. floccosa* (Griseb.) Clarke.
 9. Apex of scales acutish, the margins not pectinate-lacerate; akenes paler, transversely rugose or rugulose; spikelets not

- crowded at plant base and inflorescence not appearing lateral; Caribbean Islands or Revillagigedo Island group, Mexico.
10. Culm bases usually bulbous-thickened; akene brownish or stramineous spikelets often proliferous; Caribbean Islands. 8. *B. subaphylla* Clarke.
10. Culm bases coarse, but not bulbous-thickened; akenes grayish; spikelets not proliferous: Revillagigedo Islands, Mexico. 9. *B. nesiotica* (Johnston) Fernald.
6. Surfaces of akenes papillate or finely reticulate, the cells widely rectangular or isodiametric. 5. *B. junciformis* (H.B.K.) Lindm.
5. The plants finer, lower (usually well under 2 dm. tall); setaceous-leaved annuals or perennials.
11. Spikelets usually numerous in an involucrate, subcapitate clusters; plants of the Coastal Plain of the southeastern United States (no. 11 also in Pinar del Rio, Cuba).
12. Akene usually not much longer than 0.5 mm., the surface finely reticulate, not transversely rugose; scales of the spikelet usually reddish-brown, lustrous, smoothish; involucre bracts either shorter than the inflorescence, or only one longer. *B. barbata* (Rottb.) Clarke.
12. Akene ca. 1 mm. long, the surface transversely rugose; scales of the spikelets usually greenish or dull pale brown, puberulent; several of the involucre bracts of a cluster exceeding the inflorescence by many times its length. 11. *B. stenophylla* (Ell.) Clarke.
11. Spikelets fewer (2 or 3, rarely 5) to a cluster; low plants of the Caribbean and the Revillagigedo Islands.
13. Scales of the spikelets stramineous or yellowish-green, glabrous; akene definitely 3-lobed, stipitate, the apex retuse; inflorescence appearing lateral; Caribbean. 12. *B. setacea* (Griseb.) Svenson.
13. Scales of the spikelets reddish-brown, puberulent; akene inconspicuously trigonous or even plano-convex, broadly obovoid, the apex not retuse; spikelets appearing terminal; Revillagigedo Islands. 13. *B. sepiacea* Kral.
2. Spikelets solitary at culm tips and/or clustered at plant base or if two or more per cluster at least some pedicelled in some sort of open arrangement.
14. Spikelets solitary at culm tips and/or clustered at plant base.
15. Mature akene smooth, dark brown or blackish; robust plant with cylindrical spikelets. 7. *B. floccosa* (Griseb.) Clarke.

15. Mature akene pale, gray or brown, either cancellate or rugose; more slender, usually lower, plants.
16. Akene with fine, longitudinal lines of vertically oriented, shallow cancellae or cells; Curacao and Haiti.
 14. *B. curassavica* (Britt.) Kuekenth. & Ekman.
16. Akene not as above, characteristically transversely rugose.
17. Spikelet lanceolate, acuminate, in outline.
18. Longest involueral bract appearing as an extension of the culm, barren, usually much longer than the spikelet, the spikelet thus appearing lateral; body of fertile scale stramineous or greenish save for darker coloured, often castaneous, midrib; slender lax plants; basal spikelets lacking; Caribbean.
 15. *B. pauciflora* (Liebm.) Clarke.
18. Longest involueral bract usually not appearing as an extension of the culm, often fertile; body of the fertile scale reddish; plants more compact, usually much lower, and with basal spikelets as well as terminal, the akenes of the basal spikelets much larger; southwestern U. S. A., Mexico, and southward through Central America into South America.
 16. *B. funckii* (Steud.) Clarke.
17. Spikelet ovate or oblong in outline, not acuminata.
19. Most of the spikelets produced basally, hence much exceeded by leaves; very low annuals of the mountains of northern Mexico.
 17. *B. schaffneri* (Boeck.) Clarke.
19. Most of the spikelets produced at the tips of elongate culms, these exceeding the leaves; low or tall annuals or perennials.
20. Fertile scales stramineous or pale brown; plants perennial, smoothish or at most with scabrous scape and leaf ridges. 12. *B. setacea* (Griseb.) Svenson.
20. Fertile scales brownish or reddish-brown; plants annual, pubescent.
21. Bract subtending spikelet longer than spikelet; fertile scales prominently keeled.
22. Mature spikelet usually ca. 1 cm. long; akene usually between 1.5 and 2.0 mm. long; plant 1 dm. tall or taller.
 18. *B. trilobata* Kral.
22. Mature spikelet no longer than 0.7 cm.; akene not longer than 1.2 mm.; plants less than 1 dm. tall.
 19. *B. arcuata* Kral.
21. Bract subtending spikelet shorter than spikelet; fertile scales not prominently keeled.
 20. *B. pubescens* (Presl.) Svenson.

14. Spikelets 2 to many at the culm tips, usually in unbellate cymes or paniculate cymes, at least some solitary on peduncles or distant along the scape toward the tip.
23. Robust, tufted, the culm bases often bulbous, the scapes rigid, usually 1 mm. thick, subterete, the spikelets linear, in small, spreading, turbinate clusters, acute, in healthy material ca. 1 cm. long, the scales scarcely keeled; Caribbean.
 8. *B. subaphylla* Clarke.
23. More slender, or at least culm bases not bulbous, the spikelets ovoid or lanceolate-acuminate in outline, or, if *linear*, much less than 1 cm. long; fertile scales keeled, usually curvate.
24. Spikelets and scales of spikelets lanceolate-acuminate; spikelets with very few florets, usually 2 or 3 fertile, 2 or 3 distant along a slender, angulate scape.
 15. *B. pauciflora* (Liebm.) Clarke.
24. Spikelets and scales of spikelets ovate; spikelets with several florets.
25. Leaves and scapes noticeably spreading-pubescent or puberulent.
26. Akene prominently 3-lobed, stipitate, coarsely transversely rugose, the lobes carinate and the surfaces of these ridges colliculate.
27. Akene not longer than 1.2 mm.; plants less than 1 dm. tall. 19. *B. arcuata* Kral.
27. Akene between 1.5 and 2.0 long; plants 1 dm. tall or taller. 18. *B. trilobata* Kral.
26. Akene trigonous, but not prominently 3-lobed or stipitate, the surface transversely rugose and/or papillate.
28. Tubercle early deciduous; ripe akene brownish, its surface transversely rugose, the cells vertically oriented, linear, and so inconspicuous as to give ridges a lustrous, finely-lined appearance; plants annual.
 21. *B. hirta* (Thunb.) Svenson.
28. Tubercle persistent; ripe akene grayish or brown, its surface transversely rugose but cells of ridges prominent, often raised as papillae; plants perennial.
 22. *B. juncooides* (Vahl) Kuekenh.
25. Scapes and leaves glabrous, or at most scabrid along ridges and margins.
29. Ripe akenes gray or dark greenish-brown, waxy, papillose,
30. Plants of the Coastal Plain of the southeastern U.S.A. and local in Cuba.
31. Low annual, the inflorescence a simple to rarely compound umbel of few, lance-ovoid, spikelets; longest bract

- of inflorescence seldom exceeding inflorescence; edges of leaves usually hispidulous.
- 23. *B. ciliatifolia* (Ell.) Fern, var. *ciliatifolia*.
31. Tall perennial (usually of longleaf pine sandhills), the inflorescence usually of many, oblong or lance-linear spikelets and commonly compound; longest bract of inflorescence commonly longer than inflorescence; edges of leaves usually distinctly tuberculate-scabrid.
- 23. *B. ciliatifolia* (Ell.) Fern, var. *coarctata* (Ell.) Kral.
30. Plants primarily montane, of the southwestern United States, Caribbean, Mexico and southward into South America; tufted perennials.
- 22. *B. juncoides* (Vahl) Kuekenth.
29. Ripe akenes brownish or stramineous, papillose or rugose or both.
32. Akene prominently transversely rugose, the cells in transverse, undulating rows of vertical, narrowly rectangular, cells.
33. Akene stipitate-obovoid, often 3-lobed; 1.5-2.0 mm. long; perennial of Caribbean.
- 12. *B. setacea* (Griseb.) Svenson.
33. Akene not prominently stipitate, ca. 1 mm. long; slender annual of various provinces in the U.S.A., less frequently in Mexico and Central America.
- 24. *B. capillaris* (L.) Clarke.
32. Akene papillate, the papillae either evenly distributed or in fine, undulating, transverse lines.
34. Inflorescence open, in dense or open umbellate systems.
35. Akene 1.0-1.5 mm. long; spikelets reddish-brown to castaneous; plants perennial.
- 22. *B. juncoides* (Vahl) Kuekenth.
35. Akene ca. 0.5 mm. long; spikelets pale brown; plants annual or short-lived perennials; papillae uniform over akene surface giving it a definite pebbled texture.
- 25. *B. tenuifolia* (Rudge) Macbr.
4. Inflorescence dense, turbinate to subcapitate the spikelets linear or lance-ovoid in a contracted system of fascicles of sessile or short-stalked spikelets mixed with short-stalked cymules; longest involucrel bract exceeding the inflorescence; surface of akene finely transversely rugose, the ridges made up of rows of glistening oblong, vertical papillae; perennial of savannas, Martinique and Dominica.
- 26. *B. antillana* (Britton) Fernald.

3. *BULBOSTYLIS PARADOXA* (Spreng.) Lindm., Bih, Sv. Vet.- Akad. Handl. 26 Afd. 3 No. 9: 17, 1900.

Schoenus spadiceus H.B.K., Nov. Gen. and Sp. 1: 227. 1816. Not *S. spadiceus* Vahl. 1805.

Schoenus paradoxus Spreng., Syst. 1: 190. 1825.

Isolepis paradoxa (Spreng.) Kunth, Enum. Pl. 2: 206. 1837.

Rhynchospora perrigida Boeck., Allg. Bot. Zeitschr. 2: 93. 1896.

Stenophyllus paradoxus (Spreng.) Standley, Contr. U. S. Nat. Herb. 18: 88. 1916.

Bulbostylis spadicea (H.B.K.) Kuekenth., Repert, Sp. Nov. 23: 197. 1926.

Perennial from a stout, sparingly branched caudex, this covered by a persistent stubble of old chaffy (or burned) leaf bases and up to 4 cm. thick, and producing thickened, fibrous roots, these cloaked in a dense mycorrhizal mat. Leaves often as long as the scapes, recurved, produced in large tufts from the apex of the caudex, the blades filiform, less than 0.5 mm. broad, thickened, flat to very involute, often semicircular in cross section, the backs rounded and inconspicuously nerved, sometimes with a scattering of antrorse, stout trichomes, the margins rounded or sharp, the upper surface with a deep, median, groove, this smooth or lined with stout-based, upward-pointing trichomes. Sheaths short, dark-brown, grooved, quite thick, with broad, cinnamon-brown, scarious margins, these densely long-fimbriate. Scapes rigid, erect, much thicker than the leaf blades, smooth, angulate, sometimes flexuous, conspicuously ridged and grooved toward the base, sometimes slightly flattened distally, Spikelets ellipsoidal or obovate, ca. 1 mm. long, solitary at the culm tips; lowest bracts of the spikelet long-attenuate, the tips aristate, equalling or slightly exceeding the spikelet. Fertile scales lanceolate, pale brown or stramineous or pale reddish-brown, the margin copiously fringed with long, crisped, trichomes, the midrib conspicuously raised, greenish, long-excurrent as an attenuate mucro. Stamens 3, anthers apiculate, 3.0-3.5 mm. long. Akene broadly trigonous-obovoid or short-pyriform, brown, ca. 1.5 mm. long, the angles rounded, smooth and paler, the flat to slightly convex, transversely rugulose. Tubercle depressed globose.

Sandy savannas and pinelands, Cuba, Mexico (Oaxaca), Panama, and northern South America.

Type locality: Caracas, Venezuela. Type not seen.

This species is very definitely a part of fire disclimax associations. Every flowering specimen I have examined shows a basal stubble of charred leaf remnants. Notes by collectors indicate that flowering is induced by burning. Some of the stubble-covered caudices of this species are several centimeters in length, while the leaf-bearing portion of the crown is relatively short. This is an indication that the plants must attain considerable age.

4. *BULBOSTYLIS VESTITA* (Kunth) Clarke in Urban, Symb. Ant. 2: 87. 1900.

Isolepis vestita Kunth Enum. Pl. 2: 210. 1837.

Oncostylis vestita (Kunth) Nees in Mart. Fl. Bras. 2¹: 88. 1842.

Oncostylis hispida Liebm. Vidensk. Selsk. Skr. V. 2: 240. 1851.

Scirpus hirtus Griseb. Cat. Pl. Cub. 241. 1866.

Scirpus vestitus (Kunth) Reichenb. ex Boeck., Linnaea 36: 753. 1870.

Fimbristylis vestita (Kunth) Hemsl., Biol. Centr. Am. Bot. 3: 460. 1885.

Stenophyllus vestitus (Kunth) Britton, Bull. Torrey Club 43: 446. 1919.

Bulbostylis langsdorffiana Clarke in Urban, Symb. Ant. 2: 89. 1900. pro parte.

Perennial, in dense tufts, to 5 dm. (but usually smaller), the foliage and scapes spreading-hirsute, the culm bases thickened, brownish, usually invested in shreds of old leaf bases. Leaves up to 2/3 the length of the mature scapes, the blades linear-filiform, spreading-recurved, ca. 0.5 mm. wide, twisted, thickened, flat or somewhat involute, the backs with three, prominently raised ribs and with two more comprising a rounded and thickened margin; leaf sheaths hirsute with broad, scarious, bale-brown or cinnamon coloured margins, these sparsely fimbriate apically with pale, crisped hairs. Scapes rigid, angulate, wider than leaf blades, prominently ridged and grooved, the ridges spreading-hirsute. Spikes lance-ovoid, few-flowered, ca. 4-5 mm. long, subsessile in a solitary, subcapitate, bracteate cluster or in a simply branched system of few-spikeleted, turbinate clusters, one sessile and 1-6 on spreading or ascending branches; bracts of a cluster acicular to filiform, the longest often overtopping the cluster. Fertile scales ovate-lanceolate to ovate, acuminate or acute, curvate-keeled, reddish-brown, hirtellous, the midrib paler or greenish and at least on the lower scales prominently excurrent as a long, often somewhat reflexed mucro. Stamens 3, anthers apiculate, ca. 1. mm. long. Akenes trigonous-obovoid, ca. 1 mm. long, stramineous to pale brown or gray brown, the angles rounded and often paler, the interfaces finely transversely rugose and convex, of tiny, vertically oriented, often dark isodiametric or oblong, papillae. Tubercle depressed-conic or depressed globose.

Sandy savannas, fields, roadsides or clearings in oak-pine forest, Cuba, Puerto Rico, Haiti, Mexico (states of Oaxaca, Jalisco, Michoacan, Nayarit, Chiapas, Veracruz), British Honduras and in South America.

Type locality: Surinam. Type not seen by writer.

A clearly marked species because of its densely tufted, very hirsute foliage, its inflorescence of tight clusters of small reddish spikelets, and its finely papillate akenes. Often found mixed with *B. junciformis*, but easily distinguished even in the vegetative condition by its denser tufts of hairy leaves.

5. *BULBOSTYLIS JUNCIFORMIS* (H.B.K.) Lindm., Bih. Sv. Vet.-Akad. Handl. 26 Afd. 3 No. 9: 19. 1900.

Isolepis junciformis H.B.K., Nov. Gen. and Sp. 1: 222. 1816.

Scirpus junciformis (H.B.K.) Poir., in Lam., Encyc. Suppl 5: 105. 1817.

Scirpus humboldtii Spreng., Syst. 1: 1825.

Oncostylis junciformis var. *humboldtiana* Nees in Mart., Fl. Bras. 2¹: 86. 1842.

Bulbostylis papillosa Kuekenth., Repert. Sp. Nov. 23: 198. 1926.

Fimbristylis papillosa (Kuekenth.) Alain, Bull. Torrey Club. 92: 290. 1965.

Perennial, the culms solitary or in small tufts, to 5 dm. tall, the culm bases often bulbous-thickened. Leaves smooth about 1/2 the length of the mature scapes, the blades linear, flattened or somewhat involute, thickened, sometimes 1 mm. or slightly more (-2) broad, the backs prominently 5 nerved, two nerves comprising the cartilaginous-thickened, antrorsely scabrid margin: sheaths brownish or cinnamon, hard, but with a broad, subscarios margin, this with long, pale fimbriae apically. Scapes rigid, ascending, about the width of the leaf blades or slightly wider, angulate, prominently ridged-and-grooved, smooth. Spikelets lance-ovoid, acute, ca. 3-5 mm. long either subsessile in dense, subcapitate, involucreal clusters or in a dense ascending fan-like system made up of several primary rays terminating in small glomerules, the whole inflorescence much longer than broad. Longest bract overtopping the inflorescence in the head-like type, but overtopped by the inflorescence in the elongate type. Fertile scales lance-ovate, curvate-keeled, few to a spikelet, dark chocolate brown to mahogany, smooth to papillose-puberulent, acute, the midrib conspicuous, pale brown to greenish, excurrent as a short, erect or slightly recurved mucro. Stamens 3, anthers ca. 1 mm. long, apiculate. Akene narrowly to broadly obovate, or oblong, obscurely trigonous, 0.8-1.2 mm. long, yellowish, brownish or gray, the surfaces honeycomb—reticulate or papillate, (imparting a finely "pebbled" look.) Tubercle persistent, compressed-globose.

Savannas, open woods and pinelands, usually on sandy soil, Cuba, Haiti, Santo Domingo, Jamaica, Mexico (Oaxaca, Chiapas, Veracruz, Tamaulipas, Jalisco), British Honduras, Panama and South America.

Type locality: Northeastern Venezuela. Type not seen by this writer.

Examination of a series of specimens identified variously as *Bulbostylis junciformis* and as *B. papillosa* reveals considerable intergradation of characteristics that are supposed to distinguish the two (i.e. akene length, relative papillosity of akene, indument of spikelets, inflorescence character, etc.). Therefore I have treated the entire range of forms as *B. junciformis*, the earliest available name for the complex. My illustration is of a plant from a savanna in the Isthmus of Tehuantepec near the city of Coatzacoalcos, Veracruz, Mexico (No. 27796). On the low, rolling hills of this region, the whole spectrum of inflorescence and akene characteristics is to be found. This species in Mexico is often in association with *Abildgaardia ovata*, *Bulbostylis vestita*, *Bulbostylis tenuifolia*, *Bulbostylis pubescens*.

6. *BULBOSTYLIS WAREI* (Torr.) Clarke, Kew Bull. Add. Ser. 8: 26. 1908.

Isolepis warei Torr., Ann. Lyc. N.Y. 3: 354. 1836.

Stenophyllus warei (Torr.) Britton, Bull. Torrey Club 21: 30. 1894.

Perennial, in dense tufts, to 5 dm. tall. Leaves 1/4 to 1/2 the length of the culms, the blades narrowly linear, to 0.7 mm. wide, flat or slightly in-

volute, thick, prominently 5-ribbed, smooth or rarely distantly and antrorsely scabrid along the blade margin, the sheaths brownish or reddish-brown, smooth or scabrid along the nerves and with a broad, scarious margin, this long-fimbriate apically. Scapes stiffly spreading or ascending, angulate, noticeably wider than the leaf blades, prominently ridged and grooved, smooth. Spikelets ovate, acute, 4-5 mm. long, somewhat flattened, in a dense, headlike, terminal, turbinate or hemisphaerical involucre cluster. Longest bracts of the involucre with linear-filiform blades, usually exceeding the inflorescence, abruptly broadening toward the base where the margin is broad and prominently fimbriate-pectinate. Fertile scale ovate, acute, ciliate, somewhat keeled and with several nerves, pale brown to reddish-brown, smooth or minutely puberulent, the midrib greenish, included or slightly excurrent as a short mucro. Stamens 3, the anthers apiculate, ca. 3 mm. long. Akene broadly trigonous-obovoid, slightly more than 1 mm. broad, white or yellowish, usually 3-lobed, each lobe carinate and biconvex, the apex of the akene retuse, the interfaces coarsely and transversely rugose. Tubercle small, conic, surpassed by the projecting lobes of the akene.

Sandhills and dry sandy clearings in pine barrens, eastern North Carolina south to southern Florida and west along the coast to Escambia County, Florida.

Type locality: Tampa Bay, West Florida, *N. A. Ware*.

This species abounds in the longleaf pine-turkey oak sandhills and sand pine scrub of Florida, often in association with *B. ciliatifolia* var. *coarctata*. It is a weed on disturbed ground within the abovementioned vegetational types, but does not seem to invade other types of sandy areas, particularly roadsides, as do other *Bulbostylis* such as *B. barbata*, *B. stenophylla*, *B. capillaris*, and *B. ciliatifolia* var. *ciliatifolia*. It is a well marked species and the most robust of the U. S. species.

7. *BULBOSTYLIS FLOCCOSA* (Griseb.) Clarke in Urban, Symb. Ant. 2: 86. 1900.

Scirpus floccosus Griseb., Cat. Pl. Cub. 241. 1866.

Stenophyllus wilsoni Britton, Torreyia 13: 215. 1913.

Bulbostylis haitiensis Kuekenth., Repert. Sp. Nov. 23: 199. 1926.

Bulbostylis wilsoni (Britton) Kuekenth.; Urban, Ark. Bot. 22A; 7. 1929.

Fimbristylis floccosa (Griseb.) Alain, Bull. Torrey Club 92: 290. 1965.

Perennial, tufted, 1-2 (-3) dm. tall, with hard culm bases often sheathed in persistent old leaf bases. Longer leaves 1/2 as long to nearly as long as the culms, the blades narrowly linear, spreading, thickened, with 5 low ribs, two lateral in a slightly flattened blade or the blade subterete, the surfaces smooth save for very short hairs in the narrow grooves between the ribs. Sheaths somewhat elongate, firm, a rich reddish-brown, smooth save for a prominently ciliate-fimbriate, apex. Scapes stiff, subterete, with usually several broad, low ribs, smooth save for copious, very short hairs in the grooves. Lowest involucre bract appearing as an extension of the scape,

(hence the spikelets often appearing lateral), shorter to slightly longer than the inflorescence. Spikelets oblong or narrowly lanceolate in outline, 1.0-1.7 cm. long, acute, solitary or in small terminal clusters on the scapes and often in addition clustered at the plant base. Fertile scales spirally arranged, oblong to ovate, slightly keeled but more often rounded on the backs, pale brown to reddish-brown, acute to obtuse, smoothish to hirtellous, the margin ciliate-fimbriate, the hairs crisped, scarious save for a rigid, yellowish midrib which is slightly if at all excurrent. Stamens 3, anthers 2-3 mm. long. Akene obovate, obscurely trigonous, ca. 1 mm. long, very dark brown or almost black, smooth or minutely cancellate, the cancellae narrow, vertical. Tubercle depressed-globular.

A species of sandy beaches or sandy areas near the coast, from the Bahamas south through Cuba, and Hispaniola.

Type locality: Eastern Cuba, *C. Wright* 3381.

Robust enough to be similar to *B. nesiotica*, but differing from any other North American *Bulbostylis* in its blackish, smooth, akenes.

8. BULBOSTYLIS SUBAPHYLLA Clarke in Urban, Symb. Ant. 2: 86. 1900.
Stenophyllus subaphyllus (Clarke) Britton, Bull. Dep. Agr. Jamaica 5 (Suppl. 1): 12. 1907.

Bulbostylis alpestris Urban, Symb. Ant. 7: 168. 1912.

Bulbostylis tuerckheimii Urban, Symb. Ant. 7: 169. 1912.

Stenophyllus harrisii Britton, Torreyia 20: 83. 1920.

Bulbostylis subaphylla var. *longiglumis* Kuekenth., Repert. Sp. Nov. 23: 198. 1926.

Bulbostylis subaphylla var. *rigida* Kuekenth., Repert. Sp. Nov. 23: 199. 1926.

Bulbostylis subefimbriata Kuekenth.; Urban, Ark. Bot. 22A¹⁷: 7. 1929.

Bulbostylis hispaniolica Kuekenth. & Ekman; Urban, Ark. Bot. 22A¹⁷: 6. 1929.

Fimbristylis hispaniolica (Kuekenth. & Ekman) Alain, Bull. Torrey Club. 92: 290. 1965.

Perennial, the culms bulbous-based, in small tufts, to 4 dm. tall. Longer leaves linear-filiform, nearly as long as the culms, fleshy, often semicircular in cross section or flat, or subinvolute, with several prominent, pale ribs, two marginal, the surface smooth save for scabrid marginal ribs; sheaths short, pale or reddish brown, hispidulous, converging more or less abruptly to the blade and long or short fimbriate apically with pale, crisped hairs. Scapes rather slender but still fairly rigid, smooth, many-ribbed, subterete or slightly flattened. Lowest involucre bract rigid, seemingly an extension of the scape, shorter than to exceeding the inflorescence. Spikelets oblong-lanceolate in outline, 0.7-1.5 cm. long, somewhat flattened, acute, reddish-brown, often proliferous, rarely solitary but more usually in open (some of the rays widely spreading) or contracted cymes or subcapitate clusters. Fertile scales narrowly ovate, acute, slightly curvate-keeled, hirtellous, reddish-brown, entire, ciliate, or short-fimbriate and with an inconspicuous,

paler, midrib that is scarcely if at all excurrent. Stamens 3, the anthers apiculate, ca. 3 mm. long. Akenes trigonous-obovoid, pale brown or yellowish brown, finely rugulose, the cells vertical, very narrowly rectangular to almost linear. Tubercle depressed-conic.

Savannas, sandy areas, mountain slopes, eastern Cuba, Santo Domingo, Haiti, Jamaica.

Type locality: Cuba Oriental, *C. Wright 1533*.

This species is made up of a number of extremes in regard to inflorescence type, stature of plant, the pubescence of sheath apex. Intermediate forms are frequent.

9. *BULBOSTYLIS NESIOTICA* (I. M. Johnston) Fernald, *Rhodora* 40: 392. 1938.

Stenophyllus nesioticus I. M. Johnston, *Univ. Calif. Publ. Bot.* 7: 438. 1922.

Coarse tufted smoothish, rusty-based perennial to sometimes nearly 1 meter tall, (more usually 0.5 meter tall). Longer leaves linear, less than 1/2 the length of the mature scape, the blade smooth save for very short, pustular-based hairs on the margins, in cross section semicircular with 5 evident longitudinal veins, 3 dorsal and quite prominent and 2 marginal and somewhat less prominent; margins of leaf sheaths short, brownish, scarious, tapering gradually to the blade, long-hairy apically. Scares subterete, stiff, multicarinate, evidently wider than the leaves. Spikes elliptic-oblong, acute, 0.5-1.0 cm. long (old ones with exposed rachis may be somewhat longer), rarely solitary, usually clustered at the scape tips. Lowest involucral bract stiff, straight, the blade similar to that of the foliage leaves, slightly shorter than, equalling, or (rarely) slightly exceeding the inflorescence. Bracts of the spikelets oblong-ovate, keeled, ciliate and/or lacerate, acute, brownish save for mid-veins and margin, the surface with fine appressed puberulence; nerves of a scale yellowish, seemingly 3, the central one on lower scales sometimes slightly excurrent. Stamens 3, including the exerted tip of the connective anthers ca. 2 mm. long. Akene broadly obovoid, trigonous, ca. 1.0-1.2 mm. long, pale gray, indistinctly transversely rugose, reticulate, sometimes with the central part of the "cells" raised; tubercle of the akene pale, hemisphaeric.

Rocky shores of Revillagigedo Islands, Mexico.

Type: MEXICO. REVILLAGIGEDO ISLANDS. San Benedicto Island, *A. W. Anthony 317*. Holotype at GH, isotypes at UC, NY.

10. *BULBOSTYLIS BARBATA* (Rottb.) Clarke in *Hook. f. Fl. Brit. Ind.* 6: 651. 1893.

Scirpus barbatus Rottb. *Descr. Pl. Rar.* 27. 1772.

Isolepis barbata (Rottb.) R. Br., *Prodr.* 222. 1810.

Scirpus dussii Boeckl., *Beitr. Cyp.* 2: 38. 1890.

Stenophyllus floridanus Britton; Nash, *Bull. Torrey Club* 22: 161. 1895.

Bulbostylis floridanus (Britton) Fernald, *Rhodora* 40: 392. 1938.

Annuals, tufted, to 3 dm. tall (seldom exceeding 2 dm.). Leaves 1/4-2/3

the length of the mature culms, the blades filiform, spreading to recurved, involute, with 5 prominent nerves, the marginal ones and sometimes the dorsals antrorsely hispidulous; sheaths greenish or tan, smooth, with wide scarious margins, these fimbriate apically. Scapes filiform, slightly wider than the leaf blades, angulate, smooth. Spikelets narrowly lance-ovoid to linear or oblong, 3-7 mm. long, in a terminal, often head-like, involucrate fascicle, rarely solitary or in 2's or 3's. Longest involucral bract setaceous, rarely exceeding the inflorescence. Fertile scales lance-ovate, curvate-keeled, acute, usually entire, a rich red or reddish-brown, rarely dull brown, smooth and lustrous, the midrib prominently raised, pale or greenish, excurrent as a short, usually spreading mucro. Stamens solitary, anther ca. 1 mm. long. Akene obovoid, trigonous, 0.5-0.6 mm. long, the angles often fairly sharp, pale brown, the faces flat or slightly concave, *finely* reticulate, the cells nearly isodiametric. Tubercle short-conic.

Moist to rather dry sands of roadbanks, fields, natural and artificial clearings in the Coastal Plain of the U. S. A. from eastern North Carolina south to southern Florida and west along the Gulf to southern Louisiana; Martinique; Guatemala. Old World tropics.

Type locality: Malabar (Koenig). Type not seen by writer.

B. barbata in North America is essentially a Coastal Plain weed, being a frequent invader of cultivated ground and common enough on sandy fields in late summer to form a reddish-brown carpet of inflorescences. It appears rapidly to be expanding its range in the southeastern United States.

11. BULBOSTYLIS STENOPHYLLA (Ell.) Clarke, Kew Bull. Add. Ser. 8: 26. 1908.

Scirpus stenophyllus Ell., Bot. S. C. and Ga. 1: 83. 1816.

Dichroma cespitosum Muhl., Descr. Gram. 14. 1817.

Dichromena caespitosa Spreng., Syst. 1: 202. 1825.

Stenophyllus cespitosus (Muhl.), Raf., Neog. 4. 1825.

Isolepis stenophylla (Ell.) Torr., Ann. Lyc. N.Y. 3: 353. 1836.

Stenophyllus stenophyllus (Ell.) Britton, Bull. Torrey Club 21: 30. 1894.

Fimbristylis stenophylla (Ell.) Alain, Bull. Torrey Club 92: 290. 1965.

Annual, densely tufted, to 2 dm. tall. Leaves 1/3-2/3 the length of the culms, the blades linear-filiform (0.5 mm. wide or less), flattened or involute, thick, the backs 5-nerved, the nerves prominent, antrorsely hispidulous: sheaths brownish or stramineous, prominently nerved, hispidulous, the margins broad, scarious, long-fimbriate apically, with crisped, pale hairs. Scapes rigid, ascending, erect, somewhat broader than the leaves or spreading, prominently angulate, the ribs antrorsely hispidulous. Spikelets oblong to lance-ovoid, acute, ca. 3-5 mm. long, in dense terminal, solitary, bracteate clusters, the longest bracts lanceolate-aristate, much exceeding the inflorescence. Fertile scales ovate, curvate-keeled, acute, hispidulous or puberulent, greenish to dull brown, with a prominently raised midrib, this excurrent as a conspicuous, recurved mucro. Stamens solitary, anthers ca. 0.5 mm. long. Akene broadly trigonous-obovoid, ca. 1 mm. long,

rather sharply angled, pale or gray-brown, the faces flat or somewhat concave, finely rugose. Tubercle depressed-conic, persistent.

Sandy fields, roadsides, and clearings in pine flatwoods, Coastal Plain of the United States from eastern North Carolina south to southern Florida and west into northwestern Florida. Cuba.

Type locality: Around Beaufort, South Carolina, *Elliott*. Type at CHARL examined by writer.

In Georgia, South Carolina and Florida often mixed in populations with *B. barbata* and *B. ciliatifolia* var. *ciliatifolia* but quickly distinguished from either by its dense clusters of greenish spikelets and by its prominently elongate, setaceous-tipped, involueral bracts.

12. *BULBOSTYLIS SETACEA* (Griseb.) Svenson, Contr. Oc. Mus. Hist. Nat. Col. de la Salle 4: 10. 1946.

Abildgaardia setacea Griseb., Cat. Pl. Cub. 238. 1866.

Fimbristylis grisebachii Greenman; Combs, Trans. Acad. St. Louis 7: 474. 1897.

Fimbristylis cubensis Clarke, Ill. Cyp. pl. 43, f. 15-17. 1909.

Bulbostylis grisebachii (Greenman) Kuekenth., Repert. Sp. Nov. 23: 197. 1926.

Perennial, tufted, rarely to 3 dm. tall, the plant base often bulbous-thickened. Longer leaves 1/3 as long as the mature scapes to nearly as long, the blades filiform, with 4-5 prominent nerves, two marginal, the surfaces smoothish save for short, pustular-based hairs along the margins, less commonly on the veins below; sheaths short, with broad, pale-brown, scarious margins, the apices long-ciliate. scapes filiform, 4-5 carinate, smooth or with stout-based, short hairs along the ridges. Spikes pale brown or stramineous, lance-ovoid, 4-5 mm. long, solitary or in pairs (rarely three's) at the scape apex. Lowest involueral bract usually seeming an extension of the scape, often exceeding the spikelets, hence the spikelets usually appearing lateral. Fertile scales ovate to lanceolate, smoothish, keeled, tan or yellow-brown; nerves of the scales approximate, concentrated as a strong, greenish, midrib, this excurrent as a short erect mucro. Stamens 3, anthers ca. 1 mm. long. Akene pale brown, trigonous-obovoid, ca. 1.5-2.0 mm. long, 3-lobed, each lobe slightly carinate and tapering gradually to the akene base, the apex sharply retuse in outline, the surface between the ridges prominently and transversly rugose.

Rocky (usually limestone) pinelands and savannas, Cuba.

Type locality: Cuba. *C. Wright* 1531; 3366. Duplicates at NY examined.

13. *BULBOSTYLIS sepiacea* Kral, sp. nov.

Caespitosa subglabra humilis raro ad 2 dm. alta. Folia involuta filiformia scapos subteretes multicarinos paulum latiores dimidium aequantia. Spiculae quasi terminales, glumis rufidulo-brunneis puberulis. Achaenia subtrigona vel plano-convexa, lato-obovoidea, apice non retusa.

Tufted, low smoothish plant, rarely to 2 dm. tall. Longer leaves filiform, about 1/2 the length of the mature scape, involute, the blades with 5 promi-

ment longitudinal veins, two marginal and three dorsal, the surfaces smooth save for short, pustular-based hairs on the marginal nerves; sheaths short, the margins broad, scarious, pale-brown, tapering gradually into the blade and at this point long-fimbriate. Scapes subterete, multicarinate, slightly wider than the leaves. Spikes oblong or lance-ovoid, 5-7 mm. long (old ones with exposed rachis up to 1 cm.), solitary or in small clusters at the scape tips. Lowest involucre bract setaceous save for sheathing base, shorter than, equalling, or sometimes twice as long as the inflorescence. Fertile scales ovate, curvate-keeled, subentire, a rich reddish-brown save for the paler, nerves and the scarious margin, the surface appressed puberulent; nerves of the scale 5, approximate, not excurrent or but slightly so as a short cusp. Stamens 2 or 3, anthers ca. 1.0 mm. long, the anther connective prolonged. Akene obovate and obscurely trigonous (one face usually much wider), ca. 1 mm. long, yellowish, the surfaces finely rugose, the angles somewhat rounded and colliculate.

Crevice in rocky substrates, Revillagigedo Archipelago, Mexico.

Type locality: MEXICO. REVILLAGIGEDO ARCHIPELAGO. Socorro Island; crevice in bare rock, ridge at SE edge of plateau, summit plateau east of Mt. Everman, *R. Moran* 5838. Holotype at UC; isotype at RSA.

This plant, previously identified as *B. nesiotica* (I. M. Johnst.) Fernald, is not of the same species, in that *B. nesiotica* is much taller, much coarser, with broader, stiffer leaves and scapes (see description of that plant.).

14. *BULBOSTYLIS CURASSAVICA* (Britton) Kuekenth. & Ekman; Urban, *Ark. Bot.* 22A¹⁷: 6. 1929.

Bulbostylis floccosa var. *B* (?) *pumilio* Clarke in Urban, *Symb. Ant.* 5: 290. 1907.

Stenophyllus curassavica Britton, *Bull. Torrey Club* 43: 445. 1916.

Bulbostylis curassavica var. *pallescens* Kuekenth. & Ekman; Urban, *Ark. Bot.* 22A¹⁷: 6. 1929.

Fimbristylis curassavica (Britton) Alain, *Bull. Torrey Club* 92: 290. 1965.

Diminutive, tufted, annual rarely to 1 dm. usually 6-7 cm. tall. Leaves linear-filiform, spreading, 2/3 as long as or equalling the scapes, the blades linear-filiform, with 5 prominent pale ribs, two lateral and three dorsal, all hispidulous with ascending, short, stout-based hairs; the sheaths short, subscarious, tan, sparingly pubescent, the apices truncate, fimbriate. Scapes similar in width to the leaves, usually prominently 5-ribbed and hispidulous, in cross section therefore definitely grooved and angled. Spikelets ovoid, acute, ca. 5 mm. long, somewhat flattened, tan, solitary on the scapes and also often clustered at the plant base. Lowest involucre bract appearing as an extension of the culm, often many times longer than the spikelet, hence spikelet appearing lateral. Fertile scales subdistichously arranged, ovate, curvate-keeled, stramineous with red flecks, ciliate and subscarious save for a distinct, usually greenish, midrib, this excurrent as a short, erect mucro. Stamens 3, anthers ca. 0.7 mm. long. Aene obovoid, obscurely trigonous, ca. 1 mm. long, pale brown, lustrous, the surface foveate, with

lines of vertically oriented, rectangular, shallow pits. Tubercle somewhat darker and depressed-globose.

Solution pockets in limerock, Curacao and Haiti.

Type locality: Curacao.

This species is similar to *B. schaffneri* of the Sierras of Mexico, but differs from it in being more pubescent, with flatter spikelets, the akenes of which are foveate rather than rugose.

15. *BULBOSTYLIS PAUCIFLORA* (Liebm.) Clarke, Kew Bull. Add. Ser. 8: 26. 1903.

Oncostylis pauciflora Liebm., Vidensk. Selsk. Skr. V. 2: 241. 1851.

Stenophyllus portoricensis Britton, Torreyia 13: 216. 1913.

Bulbostylis ekmanii Kuekenth., Repert. Sp. Nov. 23: 197. 1926.

Bulbostylis portoricensis (Britton) Fernald, Rhodora 40: 392. 1938.

Fimbristylis portoricensis (Britton) Alain, Bull. Torrey Club 92: 290. 1965.

Perennial, tufted, smoothish, to 2 dm. tall, the plant bases often hard and somewhat thickened. Leaves 1/2 as long to slightly longer than the scapes, the blades filiform, usually 5-nerved but only 3 of these prominent, two forming the margin and one making a prominent mid-rib, thus the blade in cross section sometimes almost triangular; sheaths short, pale-brown, scarious, the thin margin tapering acutely to the blade, apically long-ciliate. Spikelets lance-ovoid, often narrowly so, few-flowered, ca. 0.5 cm. long, usually solitary on the scape, or two or three distant toward the scape tip. Lowest involucre bract setaceous, scabrous, seemingly an extension of the scape, usually longer than the spikelet. Fertile scales lanceolate, smoothish, scarious, prominently keeled, pale, save for a greenish to lustrous dark brown midrib of convergent nerves, this excurrent as a short cusp. Stamens 3, the anthers slightly longer than 1 mm. Akene obovoid, trigonous, ca. 1.5-1.7 mm. long, pale brown, one face (that toward axis of spikelet) wider, the surfaces prominently and transversely rugose; tubercle triangular, dark brown.

Rocky (limestone) savannas, Cuba, Puerto Rico, Haiti, St. Croix.

Type locality: St. Croix, West Indies.

Almost *Rhynchospora*-like in appearance, with its slender habit and its narrow, few-flowered, spikelets.

16. *BULBOSTYLIS FUNCKII* (Steud.) Clarke, Kew Bull. Add. Ser. 8: 26. 1908.

Isolepis funckii Steud., Syn. Cyp. 91. 1855.

Scirpus heterocarpus S. Wats., Proc. Am. Acad. 18: 171. 1883.

Stenophyllus funckii (Steud.) Britton, Bull. Torrey Club 21: 30. 1894.

Bulbostylis tenuispicata Barros, Anal. Mus. Argent. Ci. Nat. 41: 338. 1945.

Annual, tufted, to 1.5 dm. tall (usually much lower). Longer leaves spreading, from 1/2 as long to equalling the scape or rarely surpassing it, the blades linear-filiform, thickened, flat or somewhat involute, smooth, the backs prominently 3-ridged, the margins rounded, smooth or with distant,

ascending, pustular-based short trichomes, the apex acuminate. Sheaths stramineous to reddish-brown, the margins broad, scarious, fringed apically with long, pale hairs. Scapes about the width of the leaf blades, angulate to somewhat flattened in cross-section, prominently, often sharply, ridged and channelled, the ridges often ascending-hispidulous distally. Spikelets of two sorts: terminal spikelets narrowly lance-ovoid or cylindrical, acuminate, 5-7 mm. long, solitary at the culm tips or appearing lateral to the lowest bract which appears as an extension of the culm, the fertile scales few, lanceolate, straight, prominently keeled, smooth, reddish-brown save for a prominently excurrent, greenish, midrib, the scale bases sometimes saccate and pushed out still further by the expanding akenes, the margins entire, lacerate or ciliate; basal spikelets sessile or subsessile, partly hidden by the foliage leaves or the foliage leaves themselves bearing florets in their axils, the fertile scales prominently curvate-saccate, forming a membranous covering over the ripe akenes. Stamens 2, anthers 0.5 mm. long. Akene broadly trigonous-obovoid, sometimes subglobose, those of the basal spikelets ca. 1.5 mm. long, those of the scapes usually slightly less than 1 mm. long; faces of the akene lustrous, slightly convex, finely and transversely rugose with rows of very fine, vertically oriented, lense-shaped, low, papillae. Tubercle conic to subglobose.

Sandy roadbanks, clearings in forest or savanna, lawns and fields, in the United States only in southern New Mexico and Arizona, in Mexico in the states of Chihuahua, Jalisco, Mexico, Michoacan, Nayarit, Oaxaca, Orizaba, San Luis Potosi, primarily in the high plateau, and southward into Central and South America.

Type locality: Venezuela. Type not seen.

Bulbostylis funckii is very weedy, being commonest on disturbed ground of overgrazed pastures or on roadsides. It is a common lawnweed in the city of Guadalajara. The species is unique in that it produces two sizes of akenes. It appears that the whole plant is morphologically a spikelet in that florets may develop in leaf axils. The basal akenes, which are often twice the size of those borne in the aerial spikelets, may develop cleistogamously; often they reach their full size without coming above the ground, looking for all the world like clusters of bulblets at the plant base. My attempts to germinate akenes of either sort has not as yet been successful.

17. BULBOSTYLIS SCHAFFNERI (Boeck.) Clarke, Kew Bull. Add. Ser. 8: 26. 1908.

Scirpus schaffneri Boeck., Bot. Jahrb. 7: 275. 1886.

Scirpus pringlei Britton, Bull. Torrey Club 15: 103. 1888.

Diminutive, tufted annual, at most to 6 or 7 cm. tall. Longer leaves often hiding spikelets, the blades filiform, flat to somewhat involute, spreading, with 5 prominent pale ribs, two marginal and three dorsal, smooth save for very short, stout trichomes along the ribs; sheaths short, pale, scarious, smooth save for a ciliate margin at the apex. Scapes short, ascending, with several sharp ribs, but often somewhat flattened and if so with short, stout-

based hairs along the marginal ribs. Spikes ovoid, rather pale, about 5 mm. long, either solitary at scape tips or clustered at the plant base. Lowest involucre bract seemingly a continuation of the scape, the spikelets hence appearing lateral. Fertile scales lance-ovate, curvate-keeled, puberulent and ciliate, stramineous (sometimes with reddish flecks) and subscarios save for a thicker, greenish or yellowish, midrib, this excurrent beyond the tip of the scale as a long, spreading or slightly recurved, harsh-margined mucro. Stamens 3, the anthers very short. Akene yellowish or pale gray, trigonous-obovoid, ca. 1 mm. long, the edges prominent, paler and granular, the rest of the surface evenly and finely transversely rugose.

Sandy or gravelly clearings in pine or oak-pine, the Sierra Mts. of Mexico (Chihuahua and San Luis Potosi); also in southern New Mexico. So small a plant as to be easily overlooked, hence rare in collections.

Type locality: San Luis Potosi, *Schaffner*.

This diminutive species of the mountains of northern Mexico is one which tends to produce sessile spikelets, these usually obscured by the tufts of leaves. As remarked upon by Svenson (1957) it is morphologically closest to the Caribbean *B. curassavica*, differing from it mainly in fruit character.

18. **BULBOSTYLIS trilobata** Kral, sp. nov.

Annua ad 3 dm. alta culmis solitariis vel in caespitibus parvis. Folia linearia scapos dimidium aequantia. Spiculae lanceo-ovoideae acute 1.0-1.3 cm. longae solitariae vel geminae vel ternae. Achaenia stipitato-obovoidea ca. 2 mm. longa prominenter triloba et tricarinata.

Annual, to 3 dm. tall, the culms solitary or in small tufts. Leaves linear, ascending, about 1/2 the length of the mature scapes, the blades flat or involute, ca. 0.5 mm. wide, with 5 prominent ridges, 3 dorsal and 2 forming a cartilaginous margin, the ridges hirsute with stiff spreading or ascending hairs, the sheaths also hirsute, with broad pale brown scarios margins, these long-ciliate at juncture with the blade. Scapes slightly wider than the leaf blades, straight, angulate, prominently ridged and grooved, the ridges hirsute with spreading hairs. Spikes lance ovoid, 1.0-1.3 cm. long, acute, solitary or in pairs or cymes of three, the rays of the inflorescence usually but slightly longer than the spikelets. Longest involucre bract either shorter than the inflorescence or exceeding it, the blade similar to the foliage leaf in vestiture. Fertile scales ovate, curvate-keeled, acute, and margin ciliate, the surface a pale reddish-brown, papillose-puberulent, the midrib prominent, greenish or greenish with a stramineous border, slightly if at all excurrent. Stamens 3, anthers ca. 1 mm. long. Akene stipitate-obovoid, ca. 2 mm. long, prominently 3-lobed and 3 carinate, pale brownish or greenish-brown, the faces coarsely and transversely rugose the carinae colliculate. Tubercle of akenes pyramidal.

Sandy areas of grass-sedge pockets in savannas, also on sandy roadbanks and fields, Mexico, (in the states of Chiapas, Oaxaca, Veracruz), Guatemala, Honduras.

Type: MEXICO OAXACA: 16.4 mi. w. Zanatepec along Mexico Highway

190 in moist sandy area of grass-sedge, *R. Kral and J. T. Murrell 27733*. Holotype at U.S.

This species most closely resembles *Bulbostylis pubescens* in its habit, its vesture, and in its fruit, but differs from that species in having prominently keeled spikelet scales, in often producing more than one spikelet on a scape, and in the more intricate sculpturing of its akene surfaces. I have not seen this new species save in association with *B. pubescens* and certainly they must be closely related. Populations of *B. pubescens* have haploid compliments of either 5 or 10 chromosomes; the two samples of *B. trilobata* thus far cytologically studied have a haploid complement of 25.

19. **BULBOSTYLIS arcuata** Kral, sp. nov.

Annua caespitosa ad 1.5 (-2.0) dm. alta. Folia longiora scapos 1/2-2/3 aequantia. Spiculae lanceo-ovoideae vel ovoideae 6-7 mm. longae solitariae vel geminatae. Achaenia obovata brevistipitata trigona 1.0-1.2 mm. longa.

Annual, tufted, to 1.5 (-2.0) dm. tall. Longer leaves 1/2 to 2/3 the length of the mature scape, the blades linear-filiform, spreading, ca. 0.2-0.3 mm. wide, involute, with 5 prominent veins, two marginal and three dorsal, the surface pubescent with spreading fine hairs; sheaths short, with broad pale scarious margins, pubescent, ciliate apically. Scapes spreading pubescent, linear-filiform, slightly twisted, prominently 5 ridged. Spikelets lance-ovoid or ovoid, 6-7 mm. long, solitary or rarely in two on a scape. Lowest involucre bract at least as long as the spikelet, sometimes twice as long or slightly more. Fertile scales lance-ovate, or ovate, puberulent, curvate-keeled, reddish-brown; midrib of scale of 5 approximate nerves, often greenish and excurrent as a spreading mucro. Stamens 3, anthers ca. 0.7 mm. long. Akene obovate, pale brown, short-stipitate, trigonous, ca. 1.0-1.2 mm. long, 3-lobed, each lobe carinate and convex-sided, the surfaces of the carinae pale and granular or colliculate, the faces transversely rugose, of rows of narrow, vertically oriented, cells.

Rocky or sandy grasslands, edges of temporary pools, sandy areas, Mexico from Baja California to Aguascalientes and Jalisco.

Type locality: MEXICO. JALISCO: depressions in grassland, on level summits 13 mi. w. Lagos de Moreno, abundant in *Hilaria-Bouteloua* turf, *R. McVaugh 17588*. Holotype at MICH.

20. **BULBOSTYLIS PUBESCENS** (Presl) Svenson, *N. Am. Fl.* 18, part 9, 543. 1957.

Abildgaardia pubescens Presl, *Rel. Haenk.* 1: 180. 1828.

Fimbristylis preslii Kunth, *Enum. Pl.* 2: 228. 1837.

Bulbostylis clavinux Clarke, *Ill. Cyp.* pl. 41, f. 1-3. 1909.

Annual, tufted, to 3.5 dm. tall. Leaves ascending, linear-filiform, from 1/3 to 1/3 the length of the mature culms, the blades involute with 5 prominently raised nerves, three dorsal and two marginal, the nerves pubescent with stiffly spreading hairs, the sheaths similarly pubescent, with broad, scarious, tan margins, these long-hairy apically. Scapes spreading or ascending, stiff, slightly broader than the leaf blades, angulate, prominently

ridged and grooved, the ridges pubescent with spreading hairs or smooth. Spikes ellipsoidal to lance-ovoid, 0.5-1.0 cm. long, acute or blunt, solitary at the scape tip. Lowest involucral bract absent or acicular, shorter than the spikelet to sometimes slightly longer. Fertile scales ovate, slightly if at all keeled, very dark brown to reddish brown or flavescent, save for a greenish or stramineous midrib, acute or obtuse, the margin lacerate or ciliate, the surface finely papillose-puberulent, the midrib of the lower-most scales excurrent as a long mucro, those higher up merely mucronate. Stamens 3, the anthers 1.5-2.0 mm. long. Akene stipitate-obovoid, prominently three-lobed, ca. 1.5 mm. long, the lobes carinate, the interfaces concave, the surface of the interfaces either prominently transversely rugose or smoothish with a honeycomb reticulation, the carinae of the lobes either smooth or colliculate.

Sandy savannas, roadsides, and pastures, Mexico in the states of Mexico, Guerrero, Oaxaca, Chiapas, Nayarit, and Sinaloa, thence south into central America and northern South America (Colombia).

Type locality: Mexico and Luzon. Type not seen by this writer.

This species is a common weed in the savannas near the Mexican Pacific Coast, in an area extending from northern Chiapas into Nayarit. It is often abundant enough during the rainier periods of late summer to become an aspect dominant, the rich brown of its masses of spikelets being conspicuous even at a distance. Populations of it inland in Mexico tend to have lower stature, and to have much darker coloured spikelets. Most specimens I have examined have rugose akenes; however there are a few examples which lack this characteristic and so I have illustrated both types.

21. *BULBOSTYLIS HIRTA* (Thunb.) Svenson, Contr. Oc. Mus. Hist. Nat. Col. de la Salle 4: 11. 1946.

Cyperus hirtus Thunb., Phytogr. Bl. 6. 1803.

Scirpus hispidulus Vahl, Enum. 2: 276. 1805.

Isolepis exilis H.B.K. Nov. Gen & Sp. 1: 224. 1816.

Fimbristylis hispidula (Vahl) Kunth, Enum. Pl. 2: 227. 1837.

Scirpus chirigota C. Wright in Sauv., Anal. Acad. Ci. Habana 8: 81. 1871.

Fimbristylis hirta (Thunb.) Kuekenth., Repert. Sp. Nov. 23: 196. 1926.
Not *F. hirta* R. & S., 1817.

Fimbristylis chirigota (C. Wright ex Sauv.) Alain, Bull. Torrey Club 92: 290. 1965.

Annual, solitary or in small tufts, to 3 dm. tall. Leaves narrowly linear, 1/4-1/2 the length of the mature scapes, the blades involute ca. 0.5 mm. wide with 5 prominent nerves, two marginal and three dorsal, the surface of the nerves spreading-pubescent or almost smooth: sheaths spreading-pubescent, with broad, scarious, brownish margins these with long, crisped, pale hairs apically. Spikelets lance-ovoid, acute, 5-6 mm. long, (2-) 3-5 (-6) in simple, open, umbellate cymes rays of the inflorescence spreading to ascending and seldom twice as long as the spikelets. Scapes angulate, slightly broader than the leaf blades, rigid, prominently ridged and grooved, the

ridges spreading pubescent. Longest bract of the inflorescence acicular, hirsute, usually shorter than the inflorescence. Fertile scales ovate, acute, curvate-keeled, papillose-puberulent, entire of finely ciliate, a dark reddish-brown save for a stramineous or greenish, slightly excurrent midrib. Stamens 3, anthers ca. 1 mm. long. Akene trigonous-obovoid, ca. 1.2 mm. long and nearly as broad, 3-lobed, brown, the faces transversely rugose and finely etched with short vertical, linear cells, the whole surface with a "greasy" lustre. Tubercle short-conic, early deciduous.

Sandy fields, savannas, clearings, Africa, Madagascar, in the New World in Cuba, Venezuela, and in Mexico (Chiapas, Oaxaca, Veracruz, Nayarit).

Type locality: South Africa. Type not seen by this writer.

This species is perhaps closest to *B. trilobata*, in habit and general appearance, but is quite distinct in its greasy-looking, plumply trigonous akenes, and in the rich chestnut-brown color of its spikelet scales which is in sharp contrast to the prominent, paler or greenish, keeled, midrib. It is here reported as new for Mexico, (Kral nos. 25367, 25641, 27540, 27553, 27747, 27796B) and is to be looked for in sandy situations throughout central America.

22. *BULBOSTYLIS JUNCOIDES* (Vahl) Kuekenh.; Osten, Anal. Mus. Hist. Nat. Montevideo II. 3: 187. 1931.

Oncostylis arenaria Nees in Mart. Fl. Bras. 2¹: 87. 1842.

Oncostylis tenuifolia var. *hirta* Liebm., Vidensk. Selsk. Skr. V. 2¹: 240. 1851.

Oncostylis tenuifolia var. *nana* Liebm., Vidensk. Selsk. Skr. V. 2: 240, 1851.

Scirpus lorentzii Boeck., Linnaea 38: 378. 1874.

Bulbostylis argentina Palla, Oesterr. Bot. Zeitschr. 57: 258. 1907.

Fimbristylis capillaris var. *pilosa* Britton, Bull. Torrey Club 15: 102. 1888.

Bulbostylis arenaria (Nees) Lindm., Bih. Sv. Vet.-Akad. Handl. 26 Afd. 3 No. 9: 19. 1900.

Bulbostylis fendleri Clarke, Kew Bull. Add. Ser. 8: 27. 1908.

Bulbostylis langsdorffiana Clarke in Urban, Symb. Ant. 2: 89. 1900.

Bulbostylis hirtella Clarke in Urban, Symb. Ant. 2: 166. 1900.

Fimbristylis savannarum Alain, Bull. Torr. Club 92: 289. 1965.

Fimbristylis juncoides (Vahl) Alain, Bull. Torr. Club 92: 290. 1965.

Perennial, caespitose, to 4 dm. tall (usually lower), the culm bases often hard, fibrous, and bulbous-thickened. Leaves from 1/4 to 1/2 the length of the mature culms, the blades involute, less than 1 mm. broad, pale green, the backs with 5 prominent ribs, two making up a pale rounded margin, the ribs smooth, antrorsely hispidulous or scabrid; sheaths brownish or stramineous, smooth or puberulent, with broad scarious margins that are long-fimbriate apically. Scapes angulate, slightly wider than the leaf blades, rigidly spreading or ascending, prominently ridged and grooved, the ridges often with spreading hairs. Spikelets lance-ovoid, acute, 4-6 mm. long few to several in open or quite compact umbellate cymes, the cymes

simple or with the primary rays themselves branched. Longest involucre bract with a filiform, leaf-like blade, this usually shorter than the inflorescence. Fertile scales ovate, prominently curvate-keeled, smooth or papillate-puberulent, usually a dark, rich reddish brown, the apex acute or rounded, the margin usually ciliate; midrib of scale raised, stramineous or pale green, included or excurrent as a short mucro. Stamens 3, anthers ca. 1 mm. long, blunt. Akene trigonous-obovoid, sometimes short stipitate, 1.0-1.5 mm. long, grayish or rarely yellowish brown or dark brown, the angles rounded and often paler, the faces transversely rugulose or even, but in either cases made up of fine, glassy-gray papillae. Tubercle persistent, subglobose.

Sands, clays or gravels of savannas, prairies, or fields, particularly at higher elevations, southwestern Texas, southern Arizona and New Mexico south through the mountains through Mexico into Argentina. Occasional in the coastal plain of Mexico and in the mountains of the Caribbean Islands.

Type locality: Montevideo, Uruguay.

Bulbostylis juncooides is perhaps the most highly variable species within the area of this treatment, and this is perhaps to be expected in light of the vast range and the large number of types of habitats occupied by the plants. It is perhaps the most abundant sedge on the heavy dark earth of the grasslands of the Mexican high plateau, here being often in association with *Fimbristylis argillicola* and *Abildgaardia mexicana*. In such situations, the species forms hard-based tufts of dozens of culms, these radiating out in a semidecumbent fashion. The inflorescence of this form is usually a simple, but often congested umbellate cyme of very dark brown spikelets, often none of the primary rays much longer than the spikelets. The lower habit and dense inflorescence may be a reflection of the higher, more exposed elevations at which these plants grow, but it is more likely genetic in that plants grown from seed in the Vanderbilt greenhouse retain these characteristics. Examples of my own collections of this form are as follows: see numbers 25114 (plants similar to this conform to the Uruguayan type material in their low habit, dense inflorescence, and smoothness); 25137 (foliage smooth); 25194 (weakly hirtellous); 25209 (foliage hirtellous); 25488 (foliage smoothish); 25501 (plants hirtellous); 25523 (plants hirtellous); 25556 (foliage smoothish); 25559 (plants slightly hirtellous); 25560 (plants hirtellous); 25584 (foliage hirtellous); 25589 (slightly hirtellous); 25735 (foliage hirtellous, the plants conforming with material at NY identified as "*Stenophyllus hirtellus* (R. & S.) Britton" or as "*Bulbostylis langsdorffiana* Clarke"); 27374 (plants smoothish); 27449 (foliage hirtellous); 27481 (foliage hirtellous); 27575 (foliage smoothish); 27608 (foliage smoothish); 27672 (foliage smoothish); 27686 (foliage hirtellous). Many of the above cited specimens are similar to examples of the variety *ampleiceps* Kuekenenthal (Osten, Anal. Mus. Hist. Nat. Montevideo II. 3: 188. 1831), and this is the entity found in the mountains of the southwestern United States. Often a single population

will be a mixture of hairy and smooth individuals; akene characteristics also tend to vary somewhat within some populations.

A second, widely occurring, form is to be found in the oak or oak-pine forested slopes of the mountains of Mexico and Central America, primarily in the western cordillera. These are taller, usually with smoothish and longer foliage; the spikelets are longer, narrower, and of a paler, reddish-brown colour. The akenes are longer, often with the inward face much broader than the other two faces, dark gray or gray brown and with paler, usually yellowish, angles. Plants of this type grown from seed in the Vanderbilt greenhouse retain all of the abovementioned characteristics, and therefore appear to represent another genetic race. Examples from my own collections are as follows: 25299, 25618, 25537, 25623, 25651, 27539, 27560, 27613, 27644, 27718, and 27721. However, there are areas where this, the type common to clearings in oak-pine forest, comes into contact with the grassland form and because intermediate forms do exist it would seem advisable to designate all as entities of a highly variable species.

A third form is encountered in Cuba and in the lower elevations of Chiapas and Veracruz in Mexico. Examples of it have been identified as *B. arenaria*. However, it is so similar to *B. juncooides* in its spikelets, its perennial habit, and in the waxy, gray, rugose appearance of its ripe akenes, that it seems more appropriate to treat it also as *B. juncooides*. Examples of it from my own collections are the numbers 25336, 27745, 27749.

23A. *BULBOSTYLIS CILIATIFOLIA* (Ell.) Fernald var. *CILIATIFOLIA*, *Rhodora* 40: 391. 1938.

Scirpus ciliatifolius Ell., *Sk. Bot. S. C. & Ga.* 1: 82. 1816.

Isolepis ciliatifolius (Ell.) Torr., *Ann. Lyc. N. Y.* 3: 352. 1836.

Stenophyllus ciliatifolius (Ell.) C. Mohr, *Bull Torrey Club* 24: 22. 1897. in part.

Stenophyllus capillaris A. *eu-capillaris* H. Pfeiffer, *Bot. Arch.* 6: 187. 1924.

Annual, in small to large tufts, to 3 dm. tall. Leaves 1/4-1/2 the length of the mature culms, the blades linear-filiform (less than 0.5 mm. wide), spreading, involute, prominently 5 ribbed, the lateral nerves comprising a thickened margin, all nerves with ascending, short, stout-based hairs, the sheaths similarly hairy with broad, scarious, stramineous margins, these fimbriate apically. Scapes angulate, slightly wider than the leaf blades, stiffly spreading or ascending, prominently ridged and grooved, either smooth or with a scattering of ascending, stout-based hairs. Spikelets narrowly ovoid, few flowered, 2-4 mm. long, usually few (3-9) in an open, umbellate cyme, rarely a compound systems, the primary rays of the inflorescence frequently 4 or 5 times the length of the spikelets and smooth or antrorsely scabrid. Lowest involucre bract acicular-setaceous, usually shorter than the inflorescence. Fertile scales broadly ovate, curvate-keeled, even cupuliform, dark reddish brown to dull brown, papillose-puberulent, ciliate, obtuse to acute, the midrib prominent, often bright green, slightly if at all

excurrent. Stamens 2 or 3, the anthers ca. 0.8 mm. long, apiculate. Akene trigonous-obovoid, slightly less than 1 mm. long, grayish, the angles rounded, the interfaces pebbled with fine papillae, these either irregularly arranged or in fine lines, imparting a delicately rugulose appearance. Tubercle persistent, compressed-deltoid.

Moist to dry sands of exposed areas of savanna, old fields, roadbanks, pastures, or flatwoods clearings, southeastern Virginia south to southern Florida, west in the coastal plain into Texas. Cuba.

Type locality: Two miles from Beaufort, South Carolina, Elliott. Type at CHARL, examined by writer.

23B. *BULBOSTYLIS CILIATIFOLIA* (Ell.) Fern. var **coarctata** (Ell.) Kral, comb. nov.

Scirpus coarctatus Ell. Bot. S. C. & Ga. L 1: 83. 1816.

Isolepis coarctata (Ell.) Torr. Ann. Lyc. N. Y. 3: 352. 1836.

Fimbristylis capillaris var. *coarctata* (Ell.) Britton, Bull. Torrey Club 15: 102. 1888.

Stenophyllus coarctatus (Ell.) Britton in Small, Fl. SE. U. S. 189. 1903.

Stenophyllus carteri Britton in Small, Bull. N.Y. Bot. Gard. 3: 420. 1905.

Stenophyllus capillaris B. *coarctata* (Ell.) H. Pfeiffer, Bot. Arch. 6: 187. 1924.

Bulbostylis capillaris var. *coarctata* (Ell.) Machr., Field Mus. Publ. Bot. 11: 5. 1931.

Bulbostylis coarctata (Ell.) Fernald, Rhodora 40: 392. 1938.

Fimbristylis carteri (Britton) Alain, Bull. Torrey Club 92: 290. 1965.

Perennial (annual in the northern part of the range), in dense tufts, to 4 dm. tall. Leaves to 1/2 the length of the culms, the blades linear-filiform (0.5 mm. wide or less), flattened or involute, thickened, prominently 5 ribbed, the lateral nerves comprising a thickened margin, the surfaces smooth or the margin antrorsely scabrid, hispidulous, or distantly papillate, the sheaths tan, stramineous, or reddish brown, hard, lustrous, and with a broad pale, scarious margin, this long-fimbriate apically. Scapes stiffly ascending or spreading, angulate, prominently several ribbed, usually smooth. Spikelets lance-ovoid, oblong or narrowly ovoid, acute, few-flowered, 3-6 mm. long, usually many in a dense or open, ascending branched system of cymules: primary rays of the inflorescence either very short, giving whole inflorescence a fascicled appearance, or elongate with symules borne on branches several times the spikelet length and the inflorescence quite diffuse. Longest involucre bract setaceous, overtopping the inflorescence in the compact fascicled type, shorter or longer than the inflorescence in the diffuse type. Fertile scales ovate, curvate-keeled, pale brown to reddish brown, glabrous to hirtellous, entire or ciliate, acute, the midrib prominent, often greenish, usually excurrent as a short mucro. Stamens 2 or 3, the anthers ca. 1 mm. long, apiculate. Akene trigonous-obovoid, sometimes pyriform, grayish ca. 1 mm. long, the interfaces flat to somewhat convex,

papillate. Tubercle persistent, compressed-globose.

Sandhills, particularly in the longleaf pine belt, southeastern Virginia to the tip of Florida, thence west in the Gulf Coastal Plain into Texas. Tennessee. Cuba.

Type locality: Beaufort, South Carolina. *Elliott*. Type at CHARL. examined. Most current workers consider *Bulbostylis ciliatifolia* and *B. coarctata* to be the same entity and it is true that an examination of any large series of specimens of this complex will reveal morphological intermediates. However, there is one extreme, that described by Elliott as *Scirpus coarctatus*, which frequents only the sandhills or at least dry sandy localities and which is a taller smoother plant with a denser inflorescence of more spikelets having longer involucre bracts, and which lives longer than one season. It is most commonly associated, in the heart of its range, with another sandhills *Bulbostylis*, *B. warei*. The other extreme is a much lower plant, more trichomiferous, with fewer spikelets in its inflorescence, with very short involucre bracts, and with a definitely annual habit. This latter extreme is more often found on moister sands, is often very weedy in old fields or in disturbed areas of pine flatwoods or at least moister sites in longleaf pine sandhills. It does not associate with *B. warei*, but is more often found with *B. barbata*, *B. stenophylla*, and *B. capillaris*. Although there are instances where it and the "coarctata" type intermingle on disturbed sandy sites, it is far weedier than the latter. In treating this complex I have found it impossible to consider both as the same entity, but at the same time cannot avoid realizing the morphological closeness of the two. My present alternative is to maintain both as varieties.

Good examples of *B. ciliatifolia* var. *ciliatifolia* from my own collections are as follows: 15216, 15542B, 18827, 19265, 22123, 25250, 22269, 22338, 22356, 22379, 22468, 27164, 28559, 28603, 28673 and 28684.

Examples of *B. ciliatifolia* var. *coarctata* from my own sets show the two extremes, namely an open inflorescence similar to that of type variety, but more compound and with a longer involucre bract, and the other type with a much more congested inflorescence (usually turbinate in outline) with an involucre bract much exceeding the inflorescence in length. They are as follows: 15301 (open inflorescence), 25542a (open inflorescence, here mixed with other variety), 15704 (open inflorescence), 17691 (closed inflorescence), 18258 (closed inflorescence), 18330 (closed inflorescence), 18388 (open inflorescence), 18981 (closed inflorescence), 19281 (open inflorescence), 19305 (open inflorescence), 19335 (closed inflorescence), 22080 (closed inflorescence), 22209 (closed inflorescence), 22336 (closed inflorescence), 22427 (open inflorescence), 22763 (open inflorescence), 22813 (closed inflorescence), 22828 (open inflorescence), 22835 (open inflorescence), 22850 (open inflorescence), 22876 (open inflorescence), 22883 (open inflorescence), 22967 (closed inflorescence), 23115 (open inflorescence), 23163 (open inflorescence), 23168 (open inflorescence), 23179 (closed inflorescence), 23175 (open inflorescence), 25876 (closed inflorescence), 27065 (closed inflorescence), 27101 (closed in-

florescence), 27152 (closed inflorescence), 27187 (closed inflorescence), 27189 (closed inflorescence), 27256 (closed inflorescence), 28748 (open inflorescence). There is no geographic correlation to open versus closed habit of inflorescence.

24. *BULBOSTYLIS CAPILLARIS* (L.) Clarke in Hook. f., Fl. Brit. Ind. 6: 652 1893.

Scirpus capillaris L., Sp. Pl. 49. 1753.

Isolepis capillaris (L.) R. & S., Syst. Veg. 2: 118. 1817.

Scirpus brachyphyllus Link, Jahrb. Gewaschsk. 1³: 78. 1820.

Isolepis brachyphylla (Link) Schultes in R. & S., Syst. Veg. Mant. 2: 64. 1824.

Scirpus muhlenbergii Spreng. Syst. 1: 207. 1825.

Fimbristylis capillaris (L.) A. Gray, Man. 530. 1848.

Isolepis radiceflora Steud., Syn. Cyp. 318. 1855.

Stenophyllus capillaris (L.) Britton, Bull. Torrey Club 21: 30. 1894.

Bulbostylis capillaris var. *crebra* Fernald, Rhodora 40: 395. 1938.

Bulbostylis capillaris var. *isopoda* Fernald, Rhodora 40: 395. 1938.

Annual, tufted, to 3 dm. tall. Leaves 1/4-1/3 the length of the mature scapes, spreading or ascending, pale green, the blades linear-filiform (ca. 0.5 mm. wide or less), smooth, involute, prominently 5-veined, two veins comprising the margin and upwardly scabrid or merely papillose of entire; sheaths glabrous with broad, tan margins, these fimbriate apically. Scapes capillary, about the width of the leaf blades or slightly wider, angulate, prominently ridged and grooved, the ridges occasionally upwardly hispidulous. Spikelets lance-ovoid or ovoid, acute, 3-5 mm. long, solitary or more usually 2 to 7 in open, umbel-like cymes with rays either quite short or several times the length of the spikelets (very occasionally the spikelets sessile in subcapitate clusters). Lowest involucral bract acicular or linear, shorter than to exceeding the inflorescence. Fertile scales ovate, curvate-keeled, smooth or finely puberulent, the apex acute, rounded, or emarginate, the surface dark reddish-brown, the margin usually ciliate apically, the midrib prominent, usually a sharply contrasting pale green or straw coloured, and either included or excurrent as a short mucro. Stamens 2, anthers ca. 0.5 mm. long. Akene trigonous-obovoid, ca. 1 mm. long, flavescent to pale brown, the edges smoothish and rounded, the faces transversely rugose, of many rows of vertical, narrowly rectangular cells. Tubercle depressed-globose.

Sandy fields, grasslands, clearings and roadsides, often quite dry sites, especially abundant in areas of outcropping arenaceous rock, various provinces of North America, Maine to Florida, west into Texas and the lake states; scattered in the prairie provinces; in the mountainous areas of California, Oregon, New Mexico, Arizona and in contiguous areas of Mexico as well as in the state of Veracruz (*Kral 25069*). Rare in Cuba, central America. Local in southern Asia.

Type locality: Virginia, *Clayton*. Phototype from LINN examined.

Bulbostylis capillaris is perhaps the most widespread and weedy species of *Bulbostylis* in North America. It especially abounds on sandy highway shoulders or on the gravel and cinders of railroad right-of-way. In areas in which sandstone or granitic rock outcrops it is frequent in and about solution pockets. Of all U. S. *Bulbostylis* it is found the furthest inland and north. In the Piedmont and in the inner Coastal Plain of the southeastern United States it may be found in sandy fields in association with *B. barbata*, *B. ciliatifolia*, and occasionally *B. stenophylla*, but does not intergrade with any of these. In inflorescence and general appearance it comes closest in appearance to *B. ciliatifolia* var. *ciliatifolia* but differs in the more reddish colour of its spikelets and in its akenes which are paler, finely rugose, rather than papillate. It is a very rapidly growing annual, often going from seedling to fruiting stage in a few weeks. Some workers have considered it conspecific with *B. juncooides*, a common sedge of similar habit of the mountains of Mexico and South America. However, that species is a hard-based perennial, usually with much darker coloured spikelets having gray-papillose akenes. Depauperate specimens of both are hard to distinguish, save by akene characteristics.

There are occasional examples of *B. capillaris* which produce basal fascicles of spikelets as well as terminal; these are most probably reactions to early drought.

25. *BULBOSTYLIS TENUIFOLIA* (Rudge) Macbr., Field Mus. Publ. Bot. 11: 5. 1931.

Scirpus tenuifolius Rudge, Pl. Guian. 18. 1805.

Isolepis bufonia H.B.K., Nov. Gen. & Sp. 1: 222. 1816.

Scirpus bufonius (H.B.K.) Poir. in Lam., Encyc. Suppl. 5: 105. 1817.

Oncostylis tenuifolia (Rudge) Nees in Mart., Fl. Bras. 2: 83. 1842.

Bulbostylis capillaris var. *tenuifolia* (Rudge) Clarke, Symb. Ant. 2: 89. 1900.

Fimbristylis bufonia (H.B.K.) Alain, Bull. Torrey Club 92: 291. 1965.

Annual or short lived perennial, in small tufts, rarely to 2 dm. tall. Longer leaves 1/2 to 2/3 the length of the mature scapes, the blades filiform, straight to somewhat twisted, prominently 5-ribbed, somewhat involute, two marginal, the surfaces smoothish or stout-ciliate toward the base; sheaths short, scarious-margined, pale-brown, tapering at acute angle to the blade proper, here long-ciliate. Scapes straight, smooth, little if any wider than the leaves, prominently 5-ridged. Spikes lance-ovoid or ellipsoidal, acute, ca. 3.0 mm. long, long-pedunculate in simple or rarely in once-compound umbellate cymes, hence the inflorescence diffuse. Lowest involucral bract usually shorter or little longer than the basal spikelet, hence usually much shorter than the entire inflorescence, and often hardly in evidence. Fertile scales ovate or oblong, slightly curvate-keeled, smooth to hirtellous, a lustrous pale brown; evident nerves of the scales 3, approximate, forming a deeper brown or greenish midrib, this very slightly or not at all excurrent. Stamens solitary, anther ca. 1 mm. long. Akene broadly obovoid-trigonal,

ca. 0.5 mm. long, yellowish or pale brown, the faces convex, low-papillate of finely colliculate.

Sandy wastelands, savannas, clearings in oak-pine or jungle scrub, northern South America, Central America, the Caribbean, Mexico.

Type locality: French Guiana. Type not seen.

A weed similar to *B. capillaris*, but more slender in habit and with smaller spikelets whose akenes are papillate rather than transversely rugose.

26. *BULBOSTYLIS ANTILLANA* (Britton) Fernald, *Rhodora* 40: 392. 1938.

Stenophyllus antillanus Britton, *Bull. Torr. Bot. Club* 43: 447. 1916.

Perennial, in dense tufts, to 3 dm. tall, the culm bases often bulbous or swollen and usually encased in persistent, chaffy old leaf bases. Longer leaves usually at least 1/2 as long as the mature scapes, the blades narrowly linear (less than 1 mm. broad), ascending, involute, the backs usually with 5 low ribs, the marginal ones with upwardly-pointing, stout-based, trichomes, the surfaces otherwise smooth. Sheaths somewhat elongate, pale brown or reddish-brown, the margin scarious, broad, and with a tuft of long, crisped hairs apically. Scapes smooth, about as broad as the leaves, ascending, conspicuously many-ribbed and channelled, subterete or somewhat flattened distally. Spikelets lance-ovoid or oblong, 5-6 mm. long, acute, very many in a dense, turbinate or hemisphaeric, glomerulate aggregation, the primary rays short, either terminating in a single spikelet or in cymules of 2 or 3 spikelets. Lowest involucre bract rigid, ascending, thickened, the blade setaceous, usually much exerted beyond the inflorescence. Fertile scales ovate, curvate-keeled, the sides a rich, reddish-brown, the midrib greenish, included or barely excurrent. Stamens 2, anthers ca. 0.8 mm. long. Akene broadly trigonous-obovoid, pale brown or stramineous, ca. 1 mm. long, the surfaces transversely rugulose with many fine undulating lines of low, glistening, contiguous, isodiametric or short-oblong papillae. Tubercle conical or depressed globose.

Dry sandy savannas, Martinique and Dominica.

Type locality: Grand Savanna, Dominica, *F. E. Lloyd* 822 (NY).

This species most closely resembles *B. ciliatifolia*, differing in its bulbous culm bases, and in its more sharply trigonous akenes, the papillae of which are arranged in a more regular system of transverse ridges.

III. *FIMBRISTYLIS* Vahl, *Enum.* 2: 285. 1806.

Perennial or annual, the culms solitary or in tufts, or variously rhizomatous, rigid or lax, leafy toward the base. Leaves filiform to narrowly or broadly linear, glabrous to pubescent, flat or involute ligulate or eligulate, the sheaths closed or partly open at maturity of the leaf. Spikelets lanceolate, oblong, ovoid or round in outline, terete or somewhat flattened or angled, either solitary and terminal on the scapes or in simple or compound umbelliform systems involving pedunculate and sessile spikelets of cymules, the whole inflorescence as well as the cymules making it up often subtended by a leafy involucre. Fertile scales glabrous or variously pubescent, sub-

distichous to more often spirally arranged, deciduous, all but the lowermost fertile. Florets perfect; perianth absent (the flower produced on a short pedicel joint which usually disarticulates with the akene). Stamens one to three, the anthers oblong, basifixed, sometimes apiculate, the two thecae at maturity longitudinally and laterally dehiscing. Style two or three-branched, the unbranched portion flattened and fimbriate for at least a portion of its length, or (more rarely) subterete or angled, the style base either flattened or swollen but in any event not persistent at the summit of the akene. Akene lenticular or trigonous; surface of akene smoothish, cancellate, or warty, usually made up of isodiametric or horizontally arranged rectangular cells, these either concave or protuberant.

Over 200 described species, in a variety of habitats in warm temperate to tropical regions of the world.

Type species; *Fimbristylis dichotoma* (L.) Vahl.

KEY TO FIMBRISTYLIS OF NORTH AMERICA⁴

1. Style 3-branched.
 2. Akene trigonous, the surfaces smooth or warty; ligule of short hairs present.
 3. The plants perennial, usually rhizomatous.

. 27. *F. complanta* (Retz.) Link.
 3. The plants annual, caespitose.

. 28. *F. autumnalis* (L.) R. & S.
 2. Akene not trigonous or only obscurely so, obovoid, the surfaces usually warty; ligule wanting; plants annual.
 4. Spikelet usually broadly ovoid to subglobose, blunt; fertile scale rounded on the backs; leaf blades laterally flattened, the leaves of a culm flabellately spreading.

. 29. *F. miliacea* (L.) Vahl.
 4. Spikelet lance-ovoid, acute; fertile scales curvate-keeled; leaf blades dorsiventrally flattened.

. 30. *F. quinquangularis* (Vahl) Kunth.
1. Style 2-branched.
 5. Ligule of short hairs present (this characteristic is not noticeable in those entities which have broadly linear, flattened, leaf blades but is difficult to detect in those extremes which have very involute, narrow, leaf blades).
 6. A system of slender, pale or reddish, rhizomes present; robust perennials with tall, wand-like, culms.
 7. Outer surfaces of spikelet scales uniformly pubescent; spikelets elliptic-oblong, the apices of the bracts acutish, and with the midrib exerted as a prominent mucro; backs of leaf bases often pubescent; plants of marshy areas around mineral or hot springs

⁴ Species numbered 27-49.

of the southwestern U.S.A. and northern Mexico.

- 31. *F. thermalis* S. Watson.
7. Outer surfaces of spikelet scales glabrous or puberulent apically (hence spikelets usually more lustrous than in no. 5); spikelets ovoid to lance-ovoid, rarely oblong, the apices of the bracts rounded, with the midrib exerted, but not as prominently as above; backs of leaf bases seldom pubescent; plants of the mid-western U. S. A. or of the Atlantic and Gulf Coast of North America.
8. Fertile scales puberulent toward the tip; scapes usually flattened, often scabrous edged, distally; edges of leaves, especially toward the tip, scabrid; akene finely but definitely reticulate; upper edges of salt marshes, duneswales, or in sweet marsh inland near the coast, Atlantic and Gulf Coastal Plain from New Jersey to southern Mexico.
- 32. *F. caroliniana* (Lam.) Fern.
8. Fertile scales usually smooth; scapes more slender, terete or broadly oval in cross section and smooth distally; edges of leaves usually not scabrid; akene smoothish or with longitudinal rows of shallow isodiametric pits; moist to wet sandy prairies, river sloughs, marshes and springy places, midwestern and western U. S. A.
- 49b. *F. puberula* (Michx.) Vahl var. *interior* (Britton) Kral.
6. Rhizomes absent or, if present, thickened and made up of stout, contiguous, culm bases; perennial or annual species.
9. Spikelets pale (stramineous on herbarium specimens, pale reddish-brown on living specimens), usually solitary, sometimes in two's or three's on a culm; akenes appearing smooth under low (10-20x) magnification, under higher magnification showing longitudinal rows of shallow pits; usually low and spreading, always smooth, annuals of Asian origin but naturalized in the coastal regions of Georgia, Florida, Alabama, and Mississippi.
- 33. *F. schoenoides* (Retz.) Vahl.
9. Spikelets darker, usually in open or congested umbellate cymes or panicles of cymes (depauperate examples with spikelets solitary at culm ends).
10. Face (one side) of akene smoothish or with many (15 or more) longitudinal rows of shallow pits or cells, thus finely striate.
11. Robust, smoothish perennials of brackish or coastal habitats such as beaches, edges of salt marsh, mangrove swamps; species of Caribbean and/or coasts of Mexico and Central America.
12. The plants usually densely caespitose, the leaf blades often poorly developed; spikelets ovoid, in a contracted cluster

- of short-peduncled cymules at culm apex; akene pale, yellowish, very delicately and shallowly reticulate or smoothish; fertile scales densely appressed pale-hairy toward the apex; of wide distribution in the Caribbean, also on the coast of Yucatan and coasts of Central and South America. 34. *F. ferruginea* Vahl.
12. The plants in tufts of fewer culms, the culm bases fibrous, bulbous-thickened or grouped into short, knotty rhizomes, the leaf blades well developed, flat and broadly linear; spikelets lance-ovoid or ellipsoidal in a diffuse umbellate cyme or system of cymes; akene pale to dark brown, with many fine, but distinct, rows of pits or horizontally oriented cells; fertile scales lacking patches of hairs at the apices; local in the Bahamas and Cuban Keys.
. 35. *F. inaguensis* Britton.
11. Annual, the leaves and often the scape spreading-hairy; weed of the Atlantic and Gulf Coastal Plain of the United States. 36. *F. tomentosa* Vahl.
10. Face (one side) of akene more coarsely reticulate, usually with 12 or less longitudinal rows of horizontally oriented, rectangular cells.
13. Perennial with spreading, hard, pale-green leaves; akenes lacking warts.
. 37. *F. dichotoma* (L) Vahl.
13. Annual with spreading or ascending leaves; akenes with or without warts.
14. Sheaths densely spreading hairy; margins of leaf blades spreading-hairy, at least toward the base; leaves broadly linear, spreading subdistichous; primary rays of umbel stiffly spreading, the inflorescence often as wide as long or wider; edges of akene with at least a few low warts; weed of Atlantic and Gulf Coastal Plain, N. C. south to northern Florida, west into Texas.
. 38. *F. decipiens* Kral.
14. Sheaths, and leaves variable in pubescence; leaves narrowly linear, usually ascending; primary rays of umbel spreading or ascending but inflorescence usually longer than broad; akenes lacking warts or copiously warty; of general distribution throughout the eastern U. S. A., Caribbean Islands, Mexico and south into South America.
. 39. *F. annua* (All.) R. & S.
5. Ligule absent.
15. Low, often densely tufted, weedy annuals; leaf blades linear-filiform.
16. Base of style with long, reflexed hairs which cloak upper part of akene body; surface of akene smoothish; Old World and

Asian, in North America found only in Cuba (and once on ballast at Camden, N.J., Sept. 1865).

- 40. *F. squarrosa* Vahl.
16. Base of style hairless or at least lacking long reflexed hairs: surface of akene reticulate.
17. Spikelets subsessile, in dense, head-like, involucrate clusters, several of the involucre bracts much longer than the inflorescence; akenes obovoid.
- 41. *F. Vahlia* (Lam.) Link.
17. Spikelets in more open (umbellate) arrangement; akenes cylindrical, almost terete.
- 42. *F. perpusilla* Harper.
15. Taller, more robust, wider-leaved, perennials.
18. Spikelets never as long as 5 mm., in dense, glomerulate, clusters of cymules, often giving the whole inflorescence a head-like appearance; tufted, hard-leaved, plants of brackish sandy situations, primarily along the coast (peninsular Florida, the Caribbean Islands, Mexico and southward).
- 43. *F. spathacea* Roth.
18. Spikelets (by seeding time) never as short as 5 mm., usually closer to 1 cm. long, in more open inflorescences; the plants usually taller, with more slender, wand-like culms.
19. Akenes with warty protuberances on angles and faces.
20. Scales of spikelet a dark chocolate brown, in the fresh condition appearing almost blackish, outer surfaces of leaf bases smooth save along margins; plants of grasslands and brackish heavy soils of Mexican high plateau.
- 44. *F. argillicola* Kral.
20. Scales of spikelet a reddish-brown or tan; outer surfaces of leaf bases pubescent, also old leaf bases persistent as shreds of long fibers; plants of reddish clay soils of open oak and oak-pine stands (usually frequently burned areas) Sierra Madre Oriental and Occidental, Mexico.
- 45. *F. pentastachya* Boeck.
19. Akenes lacking warty protuberances.
21. Plants densely caespitose, common to brackish coastal habitats; bases of leaves hard, leathery, usually very dark brown or castaneous, often quite lustrous, deeply set in substrate.
22. Spikelets at seeding time a pale brown or pale reddish-tan; tufts of well-developed plants seldom a meter tall; west coast of Mexico.
- 46. *F. pallidula* Kral.
22. Spikelets at seeding time a rich brown, reddish-brown or dark chestnut brown; taller plants of

brackish habitats on the east coast of Mexico (rarely along the western coast), or the Atlantic and Gulf Coastal Plains of the U. S. A., also found in the Caribbean Islands.

23. Spikelets arranged usually in a very compound, open system, the inflorescence at maturity therefore much longer than broad; spikelets oblong-linear or linear-lanceolate (prior to drying); longest bract of inflorescence longer than inflorescence (in most populations); brackish, usually coastal, marshes, the Caribbean Islands and the Atlantic coast of Mexico and south.

. 47. *F. spadicea* (L.) Vahl.

23. Spikelets arranged usually in a denser inflorescence which is often not much longer than broad; spikelets broader, commonly ovate or broadly ellipsoidal; longest bract of inflorescence often overtopped by inflorescence or barely longer; brackish coastal marsh, Long Island south along the Atlantic coast and west along the Gulf coast to northern Mexico, tip of Yucatan peninsula; Cuba; the Bahamas.

. 48. *F. castanea* (Michx.) Vahl.

21. Plants in small tufts or culms solitary, common to a variety of habitats in the U. S. A. (from sandy acid pineland savannas or oak barrens to heavy prairie earths) but not in brackish coastal marsh; bases of leaves thickened and hard or culm bases bulbous, but in any case more shallow-set in substrate; specimens either with stout, contracted rhizomes or with fasciculate clusters of narrow, orangish-brown, rhizomes.

24. Base of culms bulbous, often jointed together into a stout, knotty rhizome; old leaf bases often persisting as shreddy remnants; outer surface of fertile scales usually with some puberulence; savannas, prairies, grass-sedge bogs, oak or pine barrens, and upper edges of pineland ponds, U. S. A., the Atlantic and Gulf Coastal Plain westward into the High Plains.

. 49a. *F. puberula* (Michx.) Vahl. var. *puberula*

24. Base of culms rarely bulbous, usually producing fascicles of slender, orangish, rhizomes; old leaf bases not persisting as shreddy remnants; outer surface of fertile scales seldom with any puberulence; moist, usually sandy areas of prairies and along prairie rivers, Nebraska, Kansas, and central Texas west into Colorado.

49B *F. puberula* (Michx.) Vahl var. *interior* (Britton) Kral.

27. FIMBRISTYLIS COMPLANATA (Retz.) Link, Hort. Berol. 1: 292. 1827.
Scirpus complanatus Retz., Obs. 5: 14. 1789.
Cyperus complanatus (Retz.) Willd., Sp. Pl. 1: 270. 1797.
Isolepis willdenowii R. & S., Syst. 2: 120. 1817.
Trichelostylis complanata (Retz.) Nees in Wight, Contr. Bot. India 103. 1834.
Trichelostylis rudgeana Nees in Mart. Fl. Bras. 2¹: 79. 1842.
Fimbristylis obscura Fernald, Proc. Am. Acad. 36: 492. 1901.
Fimbristylis autumnalis (L.) R. & S. var. *complanata* (Retz.) Barros, Anal. Mus. Argent. Ci. Nat. 41: 334. 1945.

Perennial, either caespitose or (more commonly) rhizomatous, to 1 meter tall (usually about 2 to 4 dm. tall). Leaves ranging (often on the same plant) from 1/5 the length of the plant to the same length, the blades linear (up to 4mm. broad), stiffly ascending or spreading, flat, smooth, the backs with numerous, subequal, raised veins, the margins each with a prominent, pale, cartilaginous, ciliate-scabrid border; sheaths thicker, broader, sometimes sharply keeled, stramineous to pale brown, with a narrow to rather broad, scarious, tan to cinnamon, entire margin this usually joining the blade at an acute angle. Ligule present as a line of short, pale hairs. Scapes flat, similar to the leaves, sometimes twisted (in some coastal plants, or in plants competing with tall vegetation, the scapes may be narrower than the leaves, and somewhat angled or subterete in the cross section). Longest involucre bract with blade similar to that of the leaves, and seemingly a continuation of the scape, shorter than to much longer than the inflorescence. Spikelets linear-oblong to lanceolate in outline, usually 5 to 7 mm. long, dark brown, a rich reddish-brown, or tan, in a complex compound end to congested pedunculate system of cymes or cymules. Fertile scales ovate-lanceolate, to oblong, keeled (the keel sometimes ciliate-scabrid) entire, the midrib excurrent as a short mucro. Stamens usually 2 (rarely 3), the anthers 1.0-1.5 mm. long. Style 3-branched, much longer than the akene, trigonous at the base, subterete above toward the branches, utterly smooth. Akene trigonous-obovoid, apiculate, ca. 1 mm. long, pale brown, very finely striate-reticulate, the cells almost isodiametric to horizontally arranged, in numerous longitudinal rows, the surface also sometimes verrucose. Grasslands, savannas, grass-sedge bogs, or moist open disturbed grounds, throughout the Caribbean Islands and North America south of the United States. In both New and Old World topics.

Type locality: India (Type specimen not examined by this writer).

I have had field experience with this plant only in Mexico. There it is most abundant in the high plateau country on the heavy dark earths of grasslands or in moist soil pockets in the oak-pine belt. In the state of Durango it is occasional at elevations approaching 9,000 feet. However, it is also found in

boggy situations in the coastal plain. As might be suspected, the plants of the lower elevations are taller and have narrower scapes which in some cases are hardly at all flattened. While some descriptions would indicate a strictly caespitose habit, the plants I have seen are all rhizomatous and tend to form large clones which actually locally may dominate the vegetation of low areas of grassland. In all it is a well marked species, readily distinguishable from *F. autumnalis*, the caespitose weedy annual with which it most often has been confused.

The surface of the akene of *F. complanata* is quite variable. In some populations it is almost smooth, in others evidently reticulate, in still others verrucose. However, all these seemingly extreme characteristics tend to blend together the more samples one inspects, and there seems to be little geographic correlation.

28. *FIMBRISTYLIS AUTUMNALIS* (L.) R & S., Syst. 2: 97. 1817.

Scirpus autumnalis L., Mant. 180. 1771.

Scirpus mucronulatus Michx., Fl. Bor.-Am. 1: 31. 1803.

Scirpus michauxii Pers., Syn. Pl. 1: 68. 1805.

Trichelostylis geminata Nees, Linnaea 9: 290. 1834.

Trichelostylis mucronulatus (Michx.) Torr., Ann. Lyc. N. Y. 3: 355. 1836.

Fimbristylis frankii Steud., Syn. Cyp. 111. 1855.

Fimbristylis frankii var. *brachyactis* Fernald, Rhodora 11: 180. 1909.

Fimbristylis autumnalis var. *mucronulata* (Michx.) Fernald, Rhodora 37: 398. 1935.

Caespitose annual, usually 0.5-2.0 dm. tall. Leaves glabrous, spreading, subdistichous, from half as long as the culms to equalling the culms, the blades linear, (to 4 mm. broad), flat, the backs with numerous, raised veins, the margin a pale, cartilaginous, ciliate-scabrid border. Sheaths broader, keeled, with a broad, scarious, tan, entire margin this joining the blade at an acute angle or truncate. Ligule present as a line of short, pale hairs. Scapes flat, similar to the leaf blades, the edges often harsh. Longest involucre bract with blade similar to that of the leaves, seemingly a continuation of the scape, shorter to longer than the inflorescence. Spikelets linear-oblong to lanceolate, usually 3-7 mm. long, a pale to dark brown, in an open to densely closed paniculate system of cymes, the primary rays usually ascending. Fertile scales ovate-lanceolate, usually keeled, entire, the midrib excurrent as a mucro. Stamens usually 2, rarely 1, 0.2-0.3 mm. long. Style 3-branched, much longer than the akene, trigonous at the base, subterete above toward the branches, utterly smooth. Akene trigonous-obovoid, apiculate, ca. 1 mm. long, pale brown, the surface smooth to quite verrucose.

Moist to wet sands, peats, silts or clays, primarily of disturbed, sunny ground, various provinces of eastern North America; the Caribbean Islands, Mexico, and Central America (here usually in low grounds near the coast). Old and New World tropics.

Type locality: Virginia (Clayton); phototype from LINN examined by writer.

This species has most been confused with *F. complanata* (Retz.) Link but differs primarily in its caespitose, annual habit and much shorter anthers (*F. complanata* is perennial, usually rhizomatous).

Many forms of *F. autumnalis* exist, some undoubtedly as habitat reactions. The sculpturing of the akene face is quite varied, in that this may range from utterly smooth to quite warty. The species also varies in regard to width of leaf blade and scape, openness of inflorescence, thickness and length of spikelet, number of spikelets, and total height of plant. Lower plants with shorter, stouter spikelets have been referred either to *F. geminata* Kunth or to *F. frankii* Steud. Examples of these tend to be mostly from the northern United States and southern Canada. Taller examples with narrower, longer spikelets and more open inflorescence were referred by Fernald to the variety *mucronulata* (Michx.) Fern. These latter are primarily from the southern United States or from the Coastal Plain. In Louisiana, where I have observed the greatest number of natural populations of the southern form, there are many small ponds with vacillating shorelines. Often, in October, along such shorelines may be seen stands of early and mid-summer weeks, these occupying higher, drying shores. Such plants are usually quite tall, with diffuse inflorescence (in short, good examples of *F. autumnalis* var. *mucronulata*), but are developing shorter, axillary shoots which terminate in denser inflorescences of stouter, shorter spikelets. More recent exposures of moist area along the same pond show younger plants which are often identical to the sort of plants found in the northern U. S. This has led me to think that perhaps shorter day length coupled with cooler temperatures may be the basis for most of the variation within the species. In fact, if the specimens be of young plants most late fall collections from the southern states bear striking resemblance to summer collections made in the northeastern United States or southern Canada. (See Kral specimens 23234, 23250, 19413, 23226, 23253, and Godfrey 63203).

29. FIMBRISTYLIS MILIACEA (L.) Vahl, Enum. 2: 287. 1805.

Scirpus miliaceus L., Syst. Nat. ed. 10. 868. 1759.

Scirpus bengalensis Pers., Syn. 1: 68. 1805.

Fimbristylis littoralis Gaud. in treyc., vol. Bot. 413. 1826.

Isolepis miliacea (L.) Presl, Rel. Haenk. 1: 188. 1828.

Trichelostylis miliacea (L.) Nees in Wight, Contr. Bot. India 104. 1845.

Caespitose annual to 5 dm. tall (rarely to 1m.). Leaves equitant, distichous, from 1/2 the length of the plant to nearly as long, rigid, smooth, flabellately spreading, tapering evenly from broad, clasping sheaths into the blade, thence continuing to taper into a slender tip, the veins numerous, raised, and evenly spaced, the margin of the blade narrow, pale, cartilaginous, antrorsely ciliate-scabrid, the margin of the sheath somewhat broader, scarious, entire: sheaths keeled, often bladeless. Ligule not evi-

dent. Scapes slender, but rigid, flattened or somewhat angled in the cross section toward the base, more flattened distally, but often with a double margin along each edge. Spikelets subglobose, ovoid or short cylindrical, 2-4 mm. long, on flattened scabrous pedicels in a compound loose to congested system of cymes. Longest involucral bract usually shorter than the inflorescence. Fertile scales ovate, pale to (usually) dark brown, smooth, the apex obtuse, rounded, or emarginate, the margin entire, the midrib paler by contrast, or greenish, rarely excurrent. Stamens 1 or 2, anthers less than 1 mm. long. Style 3-branched, the unbranched portion not much longer than the akene, subterete below, more flattened and fimbriate above toward the branches. Akene obovoid, usually narrowly so, apiculate, ca. 1 mm. long, pale brown, reticulate, the cells narrowly rectangular, horizontally oriented in 4-6 rows on a face, the longitudinal ribs usually more prominent and usually verrucose.

Sandy peat, peat-muck, and silt of open areas such as savannas, pond, lake or river shores, cultivated areas (particularly rice fields), in the U. S. from N. C. south in the coastal plain into peninsular Florida, west in the Gulf into Texas. Throughout the Caribbean Islands, Mexico, Central America.

Type locality: India (phototype from LINN examined by writer).

This species is very similar to *F. quinquangularis* (Vahl.) Kunth, which has been collected from North America only in Puerto Rico. Examples of both species are, at LINN. It had been the opinion of Blake (1954) that, in that an inscription does appear on the specimen known as *F. quinquangularis* by prior authors, that plant would have to serve as the type. Such being the case, the nearest available name for what previously had been called *E. miliacea* by authors would be *E. littoralis* Gaudichaud (Freye. Voy. Bot. 413. 1826.). However, it is the opinion of Kern (1954) that there is no proof which of the two specimens may actually have been used by Linnaeus in drawing up the original description. Therefore Kern's solution has been to consider the two sheets as syntypes; accordingly he has selected the second to serve as a lectotype in order to avoid legally "an undesirable change of names for two well known plants." The alternative chosen by Kern is here adopted.

It is easy to see how Linnaeus could have placed both species under one name in that both are annual herbs of similar foliage, habit and fruit. However, they do differ consistently in shape and coloration of spikelet, *F. miliacea* having a subglobose to short-oblong, blunt spikelet and *F. quinquangularis* having a lance-ovoid, acute spikelet.

If a species of *Fimbristylis* could be called attractive, this one comes closest. The history of introduction of this weed into the U. S. A. probably parallels that of rice, in that it is a common species of the rice growing countries of the Orient. In fact, in areas of the U. S. where rice is presently being grown (i.e. Arkansas, Louisiana, and southern Texas) it is often the commonest sedge of late summer.

30. FIMBRISTYLIS QUINQUANGULARIS (Vahl) Kunth, Enum. Pl. 2: 229. 1837.

Scirpus quinquangularis Vahl, Kunth, Enum, 2: 279. 1805.

Trichelostylis quinquangularis (Vahl) Nees in Wight, Contrib. 104. 1834.

Caespitose annual to 5 dm. tall (rarely taller). Leaves equitant, ascending, from scale like and quite short to nearly as long as the culms, rather firm, tapering rather evenly from broad, clasping, wide-margined sheaths into the blade, thence tapering gradually to the tip, the veins numerous but inconspicuous save for the two marginal and one central, the blade margin itself antorsely scabrid, the sheath margin scarious, entire; Ligule not evident. Scapes slender, about the width of the leaves or slightly narrower, deeply angulate (with 3 or 4 sharp, flattened ridges), smooth. Longest involucre bract shorter than the inflorescence. Spikelets lance-ovoid, 2-3 mm. long, acute, in a diffuse paniculate system of cymes, the primary rays elongate hence the whole inflorescence usually longer than wide. Fertile scales ovate, acute to acuminate, curvate-keeled, a rich, lustrous reddish-brown, glabrous, entire, the midrib conspicuously elevated and pointed beyond the scale as a slightly recurved mucro. Stamens 1 or 2, anthers ca. 0.5 mm. long. Style 3-branched, slightly longer than the akene, the unbranched portion about the length of the branches, three-angled in the cross section, and delicately fimbriate from at least the midpoint to the branches. Akene obovoid or pyriform, ca. 1 mm. long, obscurely trigonous or subterete, pale, apiculate, reticulate with the cells horizontally oriented in 4-6 vertical rows on a face, the longitudinal ribs usually more prominent and also usually verrucose.

Sandy swamps, roadsides, and fields, Puerto Rico. A common wetland weed of the southern Orient, probably recently introduced in Puerto Rico.

Type locality: Presumably southern India. Type at C, not examined by this writer.

For the discussion of the synonymy of the species, and the nomenclatural problem that involves it and *F. miliacea*, see discussion under *F. miliacea*. *F. quinquangularis* is evidently very closely related to *F. miliacea*, but differs in having narrower, acute, more reddish spikelets and leaf blades which have dorsiventral rather than lateral flattening.

I am obliged to Professor Gonzalez-Mas, of the University of Puerto Rico, Mayaguez, for specimens of the Puerto Rican record and which I had erroneously identified earlier as *F. complanata*. These specimens are as follows: PUERTO RICO. Mayaguez. College campus, Mayaguez, A. Gonzalez-Mas 2198, 2132; Mayaguez Miradero Road, A. Gonzalez-Mas 880; Carolina, 65th Infantry Road, Banks of Rio Grande de Loiza, A. Gonzalez-Mas 1230.

31. FIMBRISTYLIS THERMALIS S. Wats., Bot. King's Expl. 360. 1871.

Rhizomatous perennial, the plants solitary or in small tufts, from 0.5-1.5 meters tall. Leaves, 1/3-1/2 the length of the scapes, the blades linear, 1-3 mm. (-4) mm. broad, flat to somewhat involute, smooth or with some pubescence toward the sheath and apex on the lower surface, veins numerous

and prominent on the lower surface, the marginal vein or veins pale, cartilaginous, ciliate-scabrid. Sheath of the scape much broader, clasping, indurate, usually with some pubescence, stramineous to dull brown, with a broad and scarious margin, this usually entire and converging to the blade at an acute angle. Ligule of short pale hairs present; upper surface of the blade just above the ligule usually puberulent. Spikelets oblong-cylindric to lance-ovoid, 1.0-2.0 cm. long, a pale, dull brown, one to many in a closed to quite open panicle system of cymes. Longest bract of the inflorescence shorter than the inflorescence. Scapes rather rigid, about the width of the leaves, glabrous, many-ridged, subterete below, progressively flattening toward the inflorescence, the edges of the flattened portion scabrous. Fertile scales ovate, subentire, a pale dull brown, the backs uniformly puberulent, the midrib by contrast paler, and exerted as a prominent cusp. Stamens 3, the anthers about 2 mm. long. Style branches 2, the style flattened and fimbriate from the base to above the point of branching. Akene lenticular-obovoid, about 1.5 mm. long, a dark lustrous brown, finely reticulate, the individual foveae horizontally rectangular, arranged in numerous, vertical lines. Joint of akene short, persistent on fruit.

Type locality: U. S. A. CALIFORNIA. SAN BERNARDINO CO.: vicinity San Bernardino, *S. B. Parish 3667*. Holotype at GH. This locality is probably Arrowhead Hot Springs, from which I have collected a series of specimens later to be distributed as topotypes (*Kral 21591*).

Wet, highly mineralized, usually sandy substrates, of marshes and banks of hot springs, or at least in desert provinces, southern California, Nevada, Utah, and Arizona, and south to the states of Baja California and Coahuila in Mexico.

F. thermalis has perhaps the most unique habitat of all the species treated here. It abounds on the hot sandy banks of hot springs or in the highly mineralized sands of marshes in desert country where the temperatures of the ground become quite high. The substrate in which it roots is often hot enough to be uncomfortable to the touch and, as one follows a stream away from the hot springs which are its source it is noticed that *F. thermalis* is gradually replaced by other sedges along the banks. Taken out of context of habitat it could easily be mistaken for the robust, Gulf Coastal *Fimbristylis caroliniana*. However it differs markedly from that species by its much more pubescent, prominently mucronate, spikelet scales, and in its usually pubescent leaf sheaths. While coastal forms of *F. caroliniana* have a haploid complement of 30 chromosomes, *F. thermalis* has but 10.

The species geographically nearest *F. thermalis* is *F. puberula* in that its variety "interior" is of the high plains of the western United States. It is not unreasonable to suppose that *F. thermalis* arose long ago from *F. puberula* at a time when a moister climate permitted a continuum of sedge habitats to exist across North America. With subsequent drying out of large areas of the West populations of this rhizomatous sedge became isolated and have adapted to the unique niche they now occupy. In fact, the only consis-

tent differences distinguishing *F. thermalis* from *F. puberula* var. *interior* are quantitative, *F. thermalis* being more pubescent (particularly on the backs of the spikelet scales) and a far more robust plant.

I have visited a locality in Coahuila where *F. thermalis* is extremely abundant on seepage areas in the vicinity of Cuatro Cienegas. In that locality it grows amongst an odd admixture of brackish soil plants such as *Cladium jamaicense*, *Distichlis spicata*, *Anemopsis californica*, *Sabatia stellaris* and *Samolus ebracteatus*. It is an area strange beyond description, the hot winds blowing from the surrounding Coahuilan desert and over these patches of rich marsh flora. The seepage itself is so filled with minerals that they precipitate in places as an actual crystalline crust, the upper portion of which literally bakes in the glaring sun.

I have been able to raise good crops of this species from fruit collected from both California and Mexico, so that it would seem that it is not dependent upon a heated soil medium save in nature.

32. FIMBRISTYLIS CAROLINIANA (Lam.) Fern., Rhodora 42: 246. 1960.

Scirpus carolinianus Lam., Ill. 1: 142. 1791.

Fimbristylis harperi Britton in Small, Fl. Miami 29. 1913.

Rhizomatous perennial, to 1.5 (-2) meters tall, the culms solitary or in small tufts, the bases rather shallowly set in the substrate. Leaves subdistichous, usually spreading, about half as long as the scapes, the blades firm, linear, 2-5 (17) mm. wide, the surface smooth or in some cases pubescent near the ligule on the upper face, the backs with several raised nerves, the margin pale, hyaline, scabrid. Leaf sheath broader, clasping, firm, a pale, to dark brown, glabrous to sparsely pubescent, with a wide stramineous, tan or reddish-brown scarious margin, this gradually or abruptly passing into the blade, and often ciliate at this point. Ligule of appressed hairs, usually complete. Scapes about the width of the leaf blade, glabrous, many ribbed, subterete toward the base, usually flattened toward the apex, in which case the edges scabrid. Longest bract of the involucre much shorter than the inflorescence to but slightly exceeding it, the back glabrous to puberulent, the margin harsh. Spikelets ellipsoidal, lance ovoid, or oblong, 0.5-1.5 cm. long, blunt to acute, a pale dull brown to reddish brown, few to many in a compound umbellate system of cymes, the edges of the peduncles scabrid. Fertile bracts ovate, glabrous or puberulent on the backs toward the apex, the margin entire, the surface marked by a thick, usually paler area of midrib, this sometimes excurrent as a short mucro. Stamens 3, the apex of the flattened filaments narrowed, the anthers about 3 mm. long. Style 2-branched, flat, fimbriate from near the base to slightly beyond the point of branching. Akene lenticular-obovoid, ca. 1 mm. long, a pale to deep brown, often lustrous, finely reticulate, the reticule being made up of several fine rows of foveae or horizontally oriented rectangular cells. Pedicel joint very short, usually persistent.

Brackish, alkaline or mildly acid sands or sandy peats of beaches, dunes, wales, lakeshores, roadside ditches, more rarely savannas or flatwoods,

coastal plain, New Jersey south into the Florida Keys and west along the Gulf to the state of Tabasco, Mexico; Cuba.

Type locality: "e Carolina. *D. Fraser.*" Holotype at Herbarium Lamark, P. Phototype examined.

F. caroliniana is one of the more robust species. It graces those portions of the Atlantic and Gulf Coastal Plain where extensive deposits of sand develop along the coast. It is abundant where salt marsh grades into circumneutral marsh, where moisture accumulates in interdune swales, or even in mildly acid marshy situations inland. Occasionally it is in association with *F. castanea*, a true brackish marsh species, but this is usually along an ecotone. It may easily be distinguished from that species by its rhizomatous, rather than caespitose, habit, by its flattened rather than rounded upper culms, by its broader, blunter leaves and by its paler spikelets.

While *F. castanea* may enroach on its habitat from the seaward side, *F. puberula* may do the same from the landward side. This is particularly the case in the state of Florida, where much of the land is either undergoing mechanical disturbance (which would tend to mix habitat types) or is recently emergent. I was once of the opinion that these two species were easily distinguished on the basis of rhizome character alone, that *F. caroliniana* invariably produces long, slender rhizomes while those of *F. puberula* are a jointed together complex of thick-bulbous, knotty, culm bases. However, some *F. puberula* have at seasons of the year long slender rhizomes in addition. Examples of this are to be found in the flat country along the St. Johns River in peninsular Florida, also in broad marsh between the Indian River and the present coast. Therefore other, supplemental characteristics must be found to distinguish *F. caroliniana* from *F. puberula*. These consist of a noticeably broader, usually spreading, leaves, a stouter and usually flattened upper scape, together with a discernible (with hand lens) usually complete ligule of hairs. Plants which exhibit such characteristics have haploid chromosome complements of either 20 or 30; the 30's are invariably the most robust plants and these are most often found in closest proximity to the present seacoast. See further discussion under *F. puberula* Michx.

33. FIMBRISTYLIS SCHOENOIDES (Retz.) Vahl, Enum. 2: 289. 1805.

Scirpus schoenoides Retz., Obs. 5: 14. 1789.

Fimbristylis inconstans Steud., Syn. Cyp. 107. 1855, fide Clarke.

Caespitose annual 1.0-3.5 (-4.0) dm. tall. Leaves 1/3-2/3 the length of the culms, the blades linear, about 1 mm. wide, smooth, flat or somewhat involute, pale green, spreading to ascending, the backs with a few prominent raised nerves, the margin evident as a narrow, thickened, distantly ciliate-scabrid border. Leaf sheath broader, firmer, with a wide, usually tan or reddish-brown, scarious entire margin, this rounded or subtruncate at junction with blade. Ligule present as line of short hairs. Scapes rather rigid, slightly narrower than the leaves, many-ribbed and subterete toward the base, becoming somewhat flattened (oval in cross section) near the inflorescence. Spikelets ovoid, 5-8 mm. long, flavescent, acute to blunt tipped,

often solitary, sometimes in twos and sessile and distant on a scape rarely in threes and laterals peduncled. Lowest bract from shorter than the subtending spikelet to much longer, the blade similar to that of the leaves. Fertile bracts broadly ovate, entire, the whole surface uniformly flavescent, the midrib indistinct save as a short mucro, the nerves apparent as paler lines. Stamens 3, the anthers about 1 mm. long. Style 2-branched, thickened at its base, otherwise flat, fimbriate from about its mid-point to the point of branching. Akene lenticular-obovoid or obpyriform, nearly 2 mm. long, nearly white to pale brown, finely reticulate, the individual depressions usually almost isodiametric, and arranged in numerous vertical lines, giving a "honeycomb" appearance to the surface. Joint of akene (pedicel) up to 1/5 the length of the fruit, usually persistent on akene.

Moist sandy clearings, savannas, roadsides, ditchbanks, flatwoods clearings, particularly on recently disturbed ground, Coastal Plain of the United States from eastern Georgia south to the tip of Florida, west along the Gulf into Mississippi. An introduction from tropical Asia.

Type locality: India ("F. schoenoides. *Cyperus monostachyos* junior, ex India orientali, Koenig"). At C. Specimen examined by this writer.

Fimbristylis schoenoides, with its pale, often solitary, spikelets, and its very finely reticulate akenes, is so distinct from other species in the range of this treatment that further comment is unnecessary. It is weedy enough to be looked for in disturbed pine flatwoods situations north into the Carolinas and west into eastern Texas. No specimens of it have been found from Mexico. In Asia it is similar (see plate 33a) to *F. polytrichoides* (Retz.) Vahl (see plate 33b) and to *F. tristachya* R. Br. (see plate 33c) both of which may have similar habit and spikelet characteristics. It differs from the former mainly by having several nerves on its fertile bracts; it differs from the latter mainly by having a shorter style. In that only this character plus anther length distinguish *F. schoenoides* from *F. tristachya*, it is possible that they are the same species. Both have the same chromosome complement, namely N equalling 5.

34. FIMBRISTYLIS FERRUGINEA (L.) Vahl, Enum. 2: 291. 1805.

Scirpus ferrugineus L., Sp. Pl. 50. 1753.

Scirpus debilis Lam., Ill. 1: 141. 1791, fide Vahl, Enum. 2: 292. 1805. Not *S. debilis* Pursh, 1814.

Scirpus ferrugineus var. *debilis* (Lam.) Poir. in Lam., Encyc. 6: 780. 1804.

Fimbristylis sublateralis Steud., Syn. Cyp. 114. 1855.

Fimbristylis ferruginea var. *compacta* Kuekenth., Repert. Sp. Nov. 23: 196. 1926.

Tufted perennial to 7 dm. tall, the outer leaves of a tuft often abbreviated, scale-like. Leaves seldom half as long as the fully developed scapes, sometimes bladeless or very short-bladed, the blades narrowly linear (up to 2 mm. broad), flat to involute, smoothish, the backs prominently ribbed, two of these forming an incrassate, pale margin, this ciliate with ascending, pale, stout-based hairs; sheaths broad, smooth, with a wide, tan or reddish-

brown, subscarious margin that forms an acute angle (or is subtruncate) and ciliate apically. Ligule present as a horizontal line of short pale hairs. Scapes rather rigid, noticeably wider than the leaf blades, many-ribbed, subterete toward the base, often somewhat flattened toward the inflorescence. Spikelets dull reddish-brown, broadly to narrowly ovoid, 0.8-1.0 cm. long, acute to blunt, rarely solitary, usually in a dense, usually simple cyme or even a subcapitate cluster (peduncles of spikelets rarely longer than 2 cm. in North American examples). Longest involucreal bract similar to leaves but shorter, usually shorter than the inflorescence or equalling it, sometimes up to twice as long. Fertile bracts ovate, pale reddish-brown, save for greenish or gray-green longitudinal mid-zone, the apex acute to obtuse, the margin entire or ciliate apically, the surface smoothish save toward the apex where pale, appressed short hairs concentrate; midrib of scale inconspicuous, the individual veins comprising it indistinct, but exerted as a short cusp. Stamens 3, the anthers short (less than 2 mm. long). Style 2-branched, flattened, the edges fimbriate from base to point of branching. Akene lenticular-obovoid, *finely* reticulate, the individual cells subisodiametric and in distinct longitudinal lines (less often of lines of narrow, horizontal rectangles). Base of akene jointed to spikelet by means of a short joint which usually breaks off with the fruit. Chromosomes N equals 10.

Type locality: Jamaica ("in Jamaicae paludibus maritimis.")

In North America found mostly in the Caribbean Islands always close to the sea or in brackish localities inland; also found in Yucatan peninsula. Of world-wide distribution in the tropics.

This species is distinguished from other brackish-habitat *Fimbristylis* by its short leaf blades, its rather plump, usually aggregated spikelets, its finely reticulated akenes, and by close-set, copious, pale pubescence of the apices of its fertile scales.

35. FIMBRISTYLIS INAGUENSIS Britton, Torreyia 13: 216. 1913.

Perennial, the culms solitary or in small tufts, to 6 dm. tall, from a knotty rhizome comprised of old, bulbous, culm bases, the old leaf bases persisting as fibrous shreds. Leaves from $1/3$ to $2/3$ the length of the culms, spreading, often distichous, the blades linear, to 4 mm. broad, flat or rarely somewhat involute, smooth or sometimes puberulent inside in the zone of the sheaths, rigid, the backs inconspicuously nerved, the marginal nerves often prominent as a cartilaginous band, entire to antrorsely ciliate-scabrid; sheaths clasping, the backs hard, a pale to deep brown, often puberulent, the margin broad, scarious, tan or reddish-brown, puberulent and also ciliate distally. Ligule usually present as a zone of ascending, pale, stout hairs. Scapes rigid, flattened distally, subterete below. Longest involucreal bract shorter than to somewhat longer than the inflorescence, rigid, the blade flat and antrorsely ciliate-scabrid, the sheath puberulent. Spikelets lance-ovoid or cylindrical, at maturity ca. 1 cm. long, acute, reddish brown, from few to several in an open or compact, simple or compound

umbellate cyme, the primary branches or rays ascending. Fertile scales oblong or ovate, smooth, the apex acute to obtuse, the margin entire or sometimes ciliate, the backs rounded: nerves of the bract low, inconspicuous, included or sometimes slightly exerted as a weak, short mucro. Stamens 3, the anthers ca. 2 mm. long. Style 2-branched, flattened, the edges fimbriate from about the mid-point to the area of branching. Akene lenticular-obovoid, 1.0-1.5 mm. long, tumid, finely reticulate, a pale to deep brown, the individual almost isodiametric cells arranged in many fine longitudinal lines.

Sandy beaches and clearings, the Bahamas, also in the Cuban Cays.

Type locality: Inagua, *Nash and Taylor 1019*. Holotype at NY.

This entity most resembles *F. caroliniana* in that it is of very robust habit, has stiff, flattened scapes, and has spreading, flattened, broadly-linear bluntish leaf blades. However, it lacks the slender rhizomes of that species, being more similar to *F. puberula* in having a system of bulbous culm bases jointed together into a stout, knotty rhizome.

36. *FIMBRISTYLIS TOMENTOSA* Vahl, Enum. 2: 290. 1805.

Fimbristylis diphylla var. *pluristriata* Clarke in Hook. f., Fl. Brit. Ind. 6: 637. 1893.

Fimbristylis podocarpa Nees in Wright, Contrib. 98. 1843.

Fimbristylis annua forma *tomentosa* (Vahl) Ohwi, Jour. Jap. Bot. 14: 578. 1938.

Caespitose annual to 7.5 dm. tall. Leaves from half as long to nearly the length of the mature culms, the blades linear 2-4 (-5) mm. broad, usually flat but sometimes slightly involute, spreading to ascending, the surfaces pubescent, the backs with several prominent raised nerves, the margin evident as a pale, cartilaginous narrow border which is ciliate-scabrid. Leaf sheath broad, usually tomentose, with a wide, brownish, subscarios margin, this long-ciliate and truncate above at juncture with blade. Ligule present as horizontal line of short pale hairs. Scapes rather rigid, subterete basally, usually flattened or oval in cross section just below inflorescence, smooth or variously pubescent. Spikelets at maturity a rich reddish-brown, lance-ovoid, 4-6 mm. long, acute, usually many in a rather dense paniculate system of cymes, the primary branches of which are usually ascending, pubescent (spikelets solitary in depauperate specimens). Longest involucrel bract exceeding inflorescence, leaflike in its vestiture, always with a prominently hairy sheath. Fertile bracts ovate, at maturity glabrous, reddish-brown, save for a paler, often greenish, area of midrib, this usually exerted as a short cusp (backs of the midrib of lowermost scales often with some hairs). Anthers 2, 0.7-1.0 mm. long. Style 2-branched, flattened, the edges fimbriate from near the base to the base of the branches. Akene obovoid, slightly apiculate, including the pedicel 1.7-2.0 mm. long, lenticular, finely foveate (pitted), the pits arranged in many vertical rows, sometimes slightly umbonate, at maturity a dark to pale brown save for the pale margin; pedicel joint persistent, up to 0.5 mm. long.

Moist to wet sands, silts or clays of disturbed habitats such as pond or river banks, roadside ditches, canals, or agricultural grounds, coastal plain from North Carolina south to northern Florida and west into Texas.

Type: Holotype at C ("ex India orient"); examined by author.

F. tomentosa is fast becoming one of the commonest weeds of ricefields in Louisiana, Texas and Arkansas; it is also not uncommon in former rice-growing areas of Georgia and the Carolinas. However, for all its present abundance, it is rare in U. S. herbaria, an indication that it may be a comparatively recent introduction. What few specimens have been collected have usually been identified either as *F. dichotoma* or as *F. annua*. However, it differs from both in finely pitted-striate character of its akenes, in its consistently hairier and wider leaves, and in the distinctly "rusty" coloration of its mature spikelets. It is an annual throughout its range and has the lowest haploid chromosome complement of the complex (N equals 5).

In the rice country of southern Louisiana it may be so abundant in late summer as to form dense stands wherever there are moist roadside ditches, or canals.

37. FIMBRISTYLIS DICHOTOMA (L.) Vahl, Enum. 2: 287. 1805.

Scirpus dichotomus L., Sp. Pl. 50. 1753.

Scirpus diphyllus Retz., Obs. 5: 15. 1789.

Fimbristylis glaucum Vahl, Enum. 2: 288. 1805.

Fimbristylis laxum Vahl, Enum. 2: 292. 1805. in part.

Fimbristylis brizoides Nees & Meyen; Nees in Mart., Fl. Bras. 2¹: 74. 1842.

Fimbristylis polymorpha Boeck., Linnaea 37: 14. 1871.

Fimbristylis annua var. *diphylla* (Retz.) Kuekenth., Repert. Sp. Nov. 23: 196. 1926.

Fimbristylis Annua f. *brizoides* (Nees & Meyen) Kuekenth., Repert. Sp. Nov. 23: 196. 1926.

Fimbristylis diphylla ssp. *diffusa* Ward, Castanea 33: 127. 1968.

Tufted perennial to 5 or even 8 dm. tall. Leaves from half as long to nearly the length of the culms, the blades linear, 2-5 mm. broad, flat to somewhat involute, often glaucous and spreading, usually smoothish or rarely the lower surface pubescent, the backs with several prominent raised nerves, the margin evident as a pale, cartilaginous border which is ciliate-scabrid; sheaths broad, usually appressed pubescent, with a wide, tan or reddish-brown, subscarious margin that is ciliate and subtruncate apically. Ligule present as a horizontal line of short hairs. Scapes rigid, subterete basally, usually flattened or oval in cross section just below the inflorescence (the edges of a flattened scape usually scabrid). Longest involucrel bract usually longer than the inflorescence, the blade similar to a leaf blade, the sheathing base sometimes pubescent and ciliate. Spikelets drab, brownish or reddish brown, usually lance-ovoid or oblong, 4-8 mm. long, acute, in an open or dense, simple to compound unbellate system of cymes (spikelets solitary in depauperate specimens). Fertile bracts broadly oblong or ovate,

the apex acute to obtuse, the margin entire; the surface smooth, a pale to dark brown save for a paler, often greenish midrib; midrib terminating at the scale apex or excurrent as a short cusp. Anthers 1 or 2, about 1 mm. long. Style 2-branched, flattened, the edges fimbriate toward the point of branching. Akene lenticular-obovoid, sometimes fairly tumid, about 1 mm. long or slightly longer, apiculate, white to brownish, striate-reticulate, the cells rectangular, shallowly concave, horizontally arranged in (5-) 10 to 12 longitudinal rows/.side, the longitudinal ribs more conspicuous than the horizontal.

On a variety of substrates so long as they are moist and sunny; savannas, roadsides, fields, grasslands, etc. in warm temperate to tropical climates of both hemispheres. Fast becoming a weed of moist, open, sandy soils throughout the lower Coastal Plain of the southeastern United States.

Type locality: India (type material consists of specimens some of which have open, some congested, inflorescence.)

As has been stated by C. E. C. Fisher (Kew Bull. 1935: 149-150) *F. dichotoma* is based on *Scirpus dichotomus* Linn. Sp. Pl. 50 (1753). This same plant was described by Linnaeus in his Fl. Zeyl. 16, which description was in turn based on both Hermann (Zeyl. 26) and Plukenet (Alm. 179, t. 119, f.3). Both of these latter citations are represented by type specimens at BM. Material from my own collections has been compared and matches with the types (thanks for the comparison are due to Prof. John Lewis of the British Museum). The species has been confused with both *F. annua* (All.) R. & S. and with *F. bisumbellata* (Forsk.) Bubani. Many authors maintain that *F. annua* is a part of the *F. dichotoma* complex; however, *F. annua* is invariably annual while *F. dichotoma* is (at least in the New World) a perennial species. Another annual plant of the Old World with smaller akenes and spikelets but with a habit similar to that of *F. dichotoma* was also often misidentified as that species; thanks again to Fisher (l.c.) this mistake has been ironed out, the correct name for the plant in this case being *F. bisumbellata* (Forsk) Bubani (for an illustration of the species, see plate 37B).

Actually, any large set of New World specimens of *F. dichotoma* and *F. annua* will show extremes that are most difficult to place. As a rule the former species in addition to being perennial, is a smoother plant, usually with broader, stiffer foliage, and almost always with no tubercles on the ribs of the akene. As a rule specimens of the latter species, in addition to being annual, are either hairy or narrower-leaved, have softer foliage, and very often have tubercles on the ribs of the akene.

Two forms of *F. dichotoma* are prevalent in North and Central America. Vegetatively both are quite similar, having distichous, usually spreading, hard leaves, these as a rule broader than those of *F. annua*. Save for the sheaths and margins of the leaves and involucre bracts, the foliage is usually smooth, very often glaucous. The scapes are rather rigid and terminate usually in an inflorescence of numerous, lance-ovoid small spikelets, which when young often have greenish tints but which age to various shades of

brown. The main difference between the two sorts of *F. dichotoma* lies in the relative denseness of the inflorescence. In one (see Kral numbers 25372, 27785, 27794, from Mexico and 25915, 25953, 25912a, 22921, 22090, 25831, 25883 from the U. S. A.; see also plate 37) the total inflorescence is made up of several, long-rayed, dense clusters of cymules. In the other (see Kral numbers 17841, 18270, 18452, 18386, 18594, 22769, 22777, 25232, 25912b, 27375, 27554, 27845, etc. from Mexico and the U. S. A.) the inflorescence is an open system of cymules. In the coastal plains of Mexico and the U. S. A. both often occur in the same locality; in the highlands of Mexico only the latter type is found. This difference in inflorescence is correlated with a difference in chromosome number, the haploid complement of plants with the closed inflorescence being 10, that of plants with an open inflorescence 15. There are pubescent examples of both, but these are far less frequent than the smooth (see Kral numbers 25615, 27562 of Mexico, and 27832 from Louisiana, U. S. A.) I have taken fruit from spikelets of both forms; these develop into plants consistently true to type. However, in that there are several specimens from Mexico and Central America which have intermediate sorts of inflorescence, it is difficult to know how to annotate the material. For convenience sake I have therefore annotated all of the forms as *F. dichotoma*, with hopes of investigating this sort of dimorphism in more detail.

38. **FIMBRISTYLIS decipiens** Kral, sp. nov.

Annua caespitosa ad 3 dm. alta foliis scapos dimidium aequantibus. Vaginae dense pilosae; laminae basin versus (vel ultra) patenti-pilosae, lato-lineares, patentes, subdistichae. Inflorescentia saepe isodiametrica vel latior, ramis primariis umbellatis rigido-patentibus. Achaenia marginibus pauciverrucosis.

Caespitose decumbent annual to about 3 dm. tall, the scapes spreading or ascending. Leaves about 1/2 as long as the mature culms, the blades linear, pale green, averaging about 2 mm. wide, the upper and lower surfaces smoothish, or with erect, long trichomes along the veins beneath, the backs with several prominent raised nerves, the margins thickened, pale-cartilaginous, with approximate to scattered, long horizontal trichomes toward the blade base, these grading into a scabrid margin distally; sheaths closed, with a broad, scarious, tan margin, this spreading-pilose also ciliate apically. Ligule present as a line of short, pale, appressed hairs. Scapes fairly rigid, multicostate, terete below, sometimes slightly flattened distally, the ridges sometimes with scattered, horizontally spreading hairs. Longest involucre bract, longer than the inflorescence, similar to leaves in width and indument of blade, the expanded sheath spreading pilose. Spikelets ellipsoidal to lance-ovoid, 5-6 mm. long, acute, stramineous to brownish, few to several in an open system of spreading, usually 1-3-spikeleted, cymules, the inflorescence usually about as broad as or broader than long. Fertile bracts broadly oblong to ovate, the apex acute to acuminate or obtuse, the margin entire and scarious, paler, the surface smooth, tan or tinted with brown, the midveins inconspicuous and pale, or the midnerve itself green;

midvein usually excurrent as a short mucro. Anthers 1 or 2, about 0.8 mm. long. Style 2-branched, flattened, the edges usually fimbriate only from about the midpoint to the base of the style branches. Akene broadly lenticular-obovoid, about 1 mm. long, pale brown or greenish-brown, the 2 edges somewhat thickened and paler, the surface ridged-reticulate, the cells rectangular and horizontally oriented in 8-11 vertical lines to a side, with the longitudinal edges more prominent than the transverse; edges of the akene usually with a few isolated papillae toward the distal end.

A weed of moist sandy roadbanks, fields, and disturbed, open usually piney woods, in the coastal plain from eastern North Carolina south to northern Florida and west into eastern Texas.

Type locality: U. S. A. MISSISSIPPI. FORREST CO.: Interstate 56 crossing of Leaf River, n. of Hattiesburg, *R. Kral* 27858. Holotype at US.

F. decipiens appears to represent an intermediate morphology between *F. dichotoma* and *F. annua*. It is so evidently a weed, and is so often in association with other weedy and introduced *Fimbristylis* (i.e. *F. miliacea*, *F. tomentosa*) that I have long worried over how to treat it. Undoubtedly a search through Old World collections would result in turning up examples. It is possible that I have annotated South American or Central American specimens of it as *F. annua*, for it is extremely difficult for me to distinguish my own processed collections of *F. decipiens* from *F. annua*.

Yet, though photographs or herbarium specimens of this plant would be difficult to distinguish from those of *F. annua* or *F. dichotoma*, it is quite a different matter in the field when one sees mixed populations of the three. It may be distinguished from *F. annua* by its harder, broader and more spreading, leaves, its more rigid scapes, and by the almost umbonate appearance of the akene. It may be quickly distinguished from *F. dichotoma* on the basis of its usually fewer-flowered and broader inflorescence, the primary rays of which are spreading, often reflexed, and by the different character of pubescence of its leaf and sheath margins. While tubercles do form on the akene, they are usually larger and fewer than those forming on verrucose examples of *F. annua*, and they are only to be found distally along the swollen edges of the fruit. Rosettes of this entity are hardly distinguishable from those of *F. dichotoma* save for the very pilose membranous sheath margins. Yet, in spite of the hard character of the leaves and plant bases, and the seemingly perennial appearance of the mature plants, *F. decipiens* lives for but one year.

Chromosome counts of *F. decipiens* have thus far shown haploid complements of but 10. This distinguishes it on a cytological basis from *F. annua* which has 15, and from examples of *F. dichotoma* that have a diffuse inflorescence which also have 15. A form of *F. dichotoma* having 10 haploid chromosomes is distinguishable morphologically even in the herbarium in that its inflorescence is made up of dense fascicles of cymules, while that of *F. decipiens* is more open, usually with less spikelets.

39. FIMBRISTYLIS ANNUA (All.) R. & S., Syst. 2: 95. 1817.
Scirpus annuus All., Fl. Ped. 2: 277. 1785.
Fimbristylis serratum Vahl, Enum. 2: 285. 1805.
Fimbristylis hirtellum Vahl, Enum. 2: 286. 1805.
Fimbristylis laxum Vahl, Enum. 2: 292. 1805.
Scirpus baldwinianus Schultes in R. & S., Syst. Veg. Mant. 2: 85. 1824.
Scirpus sulcatus Ell., Bot. S. C. & Ga. 1: 86. 1816. Not *S. sulcatus* Petit-Thouars, 1811.
Scirpus elliottii Spreng., Syst. 4²: 28. 1827.
Fimbristylis verrucosa Presl, Rel. Haenk. 1: 190. 1828.
Fimbristylis baldwiniana Torr., Ann. Lyc. N. Y. 3: 344. 1836.
Scirpus depauperatus Muhl.; Kunth, Enum. Pl. 2: 233., as syn 1837.
Fimbristylis alamosana Fernald, Proc. Am. Acad, 36: 491. 1901.
Fimbristylis holwayana Fernald, Proc. Am. Acad. 36: 492. 1901.
Fimbristylis darlingtoniana Pennell, Bartonia 15: 30. 1933.
Fimbristylis dichotoma f. *annua* (All.) Ohwi, Jour. Jap. Bot. 14: 477. 1938.
Fimbristylis diphylla var. *tomentosa* Barros, Anal. Mus. Argent. Ci. Nat. 41: 328. 1945.
Fimbristylis arenicola Wiggins, Contr. Dudley Herb. 4: 15. 1950.

Caespitos, decumbent, ascending or erect, annual, to 5 dm. tall (usually much lower). Leaves from half as long to nearly the length of the mature culms, the blades usually narrowly linear glabrous to tomentose, 1-2 (-4) mm. wide, the backs with several prominent raised nerves, the margin often pale, cartilaginous, usually ciliate-scabrid; sheaths broad, smooth or pubescent, with a wide, subscarios margin, this smooth or pubescent, pale brown, and toward its apex ciliate and truncate or acute. Lingule present as a horizontal line of short hairs. Scapes lax to rigid, ascending or erect, subterete basally, flattened or subterete above at juncture with inflorescence. Longest involucral bract similar to leaves in its width and indument, shorter or longer than the inflorescence, the sheathing base smooth or hirsute. Spikelets lance-ovoid or oblong, 3-8 mm. long, acute, greenish, tan, brown, to a dark reddish-brown, in a few to many spikeleted on simple or compound umbellate systems of cymes (spikelets solitary in depauperate specimens). Fertile bracts broadly oblong to ovate, the apex acute to obtuse, the margin entire, the surface smooth, the midrib paler, seldom excurrent. Anthers one or rarely two, about 1 mm. long. Style 2-branched, flattened, the edges fimbriate from the base to the branches, or entire basally. Akene lenticular obovoid or obovoid and quite tumid, about 1 mm. long, apiculate white to brownish, often iridescent, striate-reticulate, the cells rectangular, shallowly concave, horizontally arranged in from 5 to 12 longitudinal rows per side, the longitudinal ribs more conspicuous than the horizontal. Surface of akene often verrucose, the warts forming either along the longitudinal ribs or over entire cells.

On a variety of moist sunny substrates; savannas, roadsides, grasslands,

disturbed or cultivated areas, etc. in temperate to tropical climates of both hemispheres.

Type locality: Italy (Piedmont). Holotype at TO has been examined. It is a temptation to follow the lead of several other cyperologists and to treat this entity as part of *F. dichotoma*, especially in that it is difficult (if not impossible) to distinguish between herbarium specimens of extremes of both. However, as the name Allioni selected indicates, this is strictly an annual plant; characteristically it is smaller or at least more slender in habit. *F. dichotoma* is a perennial, usually coarser, plant.

A very large number of forms of the species are to be found, many of which have been designated species or varieties of other species, particularly *F. dichotoma*. In my experience the commonest forms are as follows: (1) a relatively tall, ascending-leaved, pubescent, reddish-brown spikeleted form with reticulate, non-verrucose akenes (see Kral numbers 7932, 15288, 18724, 27839, 21062, 22061, 22938, 25473, 25793, 25805b, 25819a (see illustration 39b), 25821, 27744, 27808, 27817, 27820); (2) a lower, usually smoothish, spreading-leaved, pale-spikeleted plant with reticulate-warty akenes (see numbers 25325, 25330, 25393, 25463, 25667, 25670, 25673, 27505, 27726 illustrated as 39a); (3) a fairly tall, usually smoothish, ascending-leaved, chestnut-brown spikeleted plant with reticulate smooth or warty akenes (see numbers 25522, 25600, 25630, 27616, 27627, 27641, 27680, 27753); (4) a low, usually smoothish, ascending or spreading-leaved, reddish brown spikeleted plant with reticulate, smooth-or-warty akenes (see numbers 13780, 13942, 18633, 22002, 22062, 22193, 22374, 22436, 22601, 22684, 22697, 24593, 25965, 25977A, 27157, 27850, 27857). The first form most often has been identified as *F. laxa* Vahl, or *F. hirtellum* Vahl, or erroneously as *F. tomentosa* Vahl: it is a common weed in central and South America, also the Orient. The second form has been identified most often as *F. baldwiniana* Torr., but, collections of it from southwestern United States and from Mexico (where it is locally abundant) have also been identified as *F. alamosana* Fernald. The third form was named *F. holuayana* by Fernald (l.c) and is not uncommon in the foothills of the Sierras of Mexico and Central America. The fourth form is widespread in the New World tropics, in the eastern United States and in southern Europe with isolated examples in the Orient; it is this form which is the type of *F. annua*, but which in the United States has long been called *F. baldwiniana*. An extreme of it, from the serpentine barrens of Pennsylvania and Delaware (Virginia?) was named *F. darlingtoniana* by Pennell.

Morphological intermediates between the above-mentioned forms do occur, and when they do, such may constitute very large, seemingly pure, populations. Fruit characters, so often reliable in distinguishing *Fimbristylis* species, are in such cases not constant enough to be useful and are indeed a reason for my treatment of all of the above sorts as one species. All forms are also held together by an annual habit, together with what is so far found to be a consistent chromosome complement, namely, N equalling 15.

The original area occupied by the species is open to conjecture. It would

appear that the greatest diversity of forms is in Austral Asia, and that at least some of the forms have been introduced to North America by way of rice culture. However the form which includes the Allioni type actually behaves like a native over a good bit of its range in the United States. It is to be found in such habitats as granite or limestone outcrops (i.e. the outcrops of Alabama, Georgia) wet areas of clearing in original forest, edges of brackish marshes, etc. as well as in weedy situations. It is easy to see how such authors as Fernald, Pennell, etc., would have considered it native. These workers made much of the verrucose character of the fruit; however, specimens of European, Asian, and South American *F. annua*, sometimes show development of some warts and therefore it is not the most reliable of characters. Such a feature often varies rather widely *within* otherwise fairly uniform populations.

40. FIMBRISTYLIS SQUARROSA Vahl, Enum. 2: 289. 1805.

Isolepis hirta H.B.K., Nov. Gen. & Sp. 1: 224. 1816.

Fimbristylis hirta (H.B.K.) R. & S., Syst. Veg. 2: 99. 1817.

Pogonostylis squarrosus (Vahl) Bertol., Fl. Ital. 1: 313. 1834.

Fimbristylis comata Nees in Wight, Contr. Bot. India 102. 1834.

Annual, caespitose, to 4 dm. tall. Leaves 1/2 as long to nearly as long as the culms, the blades linear filiform, flat, the backs rather prominently and evenly nerved, the lower surface and margin often hirtellous; sheaths soft, hirtellous or puberulent, the margins broad, scarious, pale, entire or ciliate toward the apex. Scapes slender, erect, about the width of the leaves, subterete, prominently ridged-and-grooved, smooth. Spikelets ellipsoidal or oblong, acute, 4-5 mm. long, few to many in open, umbellate or paniculate cymes, usually the inflorescence with some ascending primary rays, these several times the length of a spikelet, and either terminating in a single spikelet or in a cymule of two or three spikelets, hence the inflorescence usually longer than broad. Longest involucral bract linear-lanceolate, long-attenuate or setaceous, slightly shorter to somewhat longer than the inflorescence. Fertile scales ovate, brown or greenish brown, the backs rounded or slightly keeled, the margins entire, the surface smooth or with a scattering of short ascending hairs; midrib of fertile scale raised, usually deep green, well exerted beyond the scale as an attenuate, recurved, mucro. Stamens solitary, the anther ca. 0.5 mm. long. Akene lenticular-obovoid, slightly less than 1 mm. long, pale brown, smooth or reticulate. Style somewhat longer than the akene, 2-branched, flattened, retrorsely long-fimbriate at the base to form a fringe over the summit of the akene, smooth toward the mid-point, then sparsely fimbriate above toward the style branches.

A weed in tropical, humid situations, very common in the Old World and in tropical Asia, seemingly rare in North America having been collected only from Cuba, (C. Wright) and once on ballast at Camden, N.J. (C. F. Parker).

Type locality: South America. The type specimen, obligingly sent from C, shows good material of one plant plus a top from another. There is no

problem in identification but the caption on the specimen is sketchy: "Fimbristylis squarrosus e collect Amer. Loeft. dedit Ortega."

According to Koyama (1961), this small sedge is but a variant of *Fimbristylis aestivalis* (Retzius) Vahl. Both are diminutive, eligulate, and have similar akenes, inflorescence, and spikelet shapes. However, *F. aestivalis* is smoother, and lacks the elongate-recurved midrib character of bract, also the recurved fimbriate character of style base that is so distinctive in *F. squarrosa*. I feel that these constitute specific rather than varietal differences, hence am retaining the previous nomenclature. Only experimentation with the two entities can decide the matter. For purposes of comparison I have drawn typical examples of both (see plates 40a, 40b).

41. FIMBRISTYLIS VAHLII (Lam.) Link, Hort. Berol. 1: 287. 1827.

Scirpus vahlii Lam., Ill. 1: 139. 1791.

Isolepis vahlii (Lam.) H.B.K., Gen. & Sp. 1: 221. 1816.

Fimbristylis congesta Torr., Ann. Lyc. N. Y. 3: 345. 1836.

Fimbristylis vincentii Steud., Syn. Cyp. 109. 1855.

Scirpus apus A. Gray, Proc. Am. Acad. 10: 78. 1874.

Fimbristylis apus (A. Gray) S. Wats., Bot. Calif. 2: 224. 1880.

Caespitose low annual, the culms to 1.5 dm. tall (usually much lower). Leaves 1/3 as long as the scape to equalling or exceeding it, the blades linear-filiform, spreading recurved less than 1 mm. broad, somewhat involute, the backs with several prominent, raised veins often with small, stiff, ascending hairs, the margin somewhat thickened and similarly hairy. Leaf sheath broad, stramineous or pale brown, usually smooth or with a scattering of small hairs, the margin scarious, entire, passing gradually into the blade. Ligule absent. Scares stiffly ascending, wiry, slightly broader than the leaves, glabrous, many-ribbed, subterete. Spikelets lance-ovoid, linear-ellipsoidal or oblong, 0.5-1.0 cm. long, usually acute, pale greenish-brown, 3-8 in a dense terminal cluster, this subtended by several leaf-like involucral bracts, these always exceeding the inflorescence and usually at least the length of the basal leaves. Fertile bracts ovate-lanceolate or oblong-lanceolate, glabrous, stramineous or pale green, the midrib conspicuous, dark green, and pointed beyond the scale as a short, erect or slightly recurved, mucro. Stamen 1, the anther less than 0.5 mm. long. Style 2-branched, much longer than the akene, subterete, the base swollen, the surface smooth, or papillate from about the midpoint to the point of branching. Akene obovoid, tumid, 0.5-0.7 mm. long pale, sometimes slightly iridescent, reticulate, the individual rectangular cells arranged horizontally in 5-7 vertical rows on a side.

Fine sands, silts or clays, usually alluvial or shoreline situations, often on areas of disturbed bottomland, South Carolina south to northern Florida, west to Texas; scattered localities in inland states (Kentucky, Illinois, Missouri, Arkansas, Oklahoma and Kansas); in the western United States, California and Arizona; Mexico and into Central America beyond the range of this study.

Type: "Habitat in America meridionali, nec in Hispania" (Vahl, Enum. 2: 263). Not seen by writer.

Fimbristylis vahlii together with the extremely rare *F. perpusilla* Harper, comprise the two most diminutive species of the genus in North America. It is very much a weed, being most often found on fine textured, often alluvial, soil such as would be recently exposed by receding water. In Texas and Louisiana it is most often seen around farm ponds, artificial lakes, backwaters of rivers and streams, or borrow pits. It is most often in association with such *Fimbristylis* as *F. autumnalis*, *F. miliacea* and *F. annua*, but is found further west in the United States than any of these although its occurrence in the western United States is sporadic. Fruiting plants may develop from seed in a few weeks time, an indication that this is a species extremely efficient in getting the most out of the sort of temporary habitat it occupies.

42. FIMBRISTYLIS PERPUSILLA Harper in Small, Fl. SE. U. S. 188. 1903.

Solitary or tufted, low glabrous annual, the culms to 8 cm. tall (usually lower). Leaves from 1/3 the length of the scape to equalling or exceeding it, the blades linear-filiform, less than 1 mm. broad, spreading involute, the backs with 3, prominently raised veins, the margin composed of similar, ciliate-scabrid, veins; sheath much broader, with an entire, broad, scarious margin, this converging with the blade at an acute angle. Ligule absent. Scapes stiffly ascending, wiry, slightly broader than the leaf blades, many-ribbed, flattened to subterete. Spikelets ovoid to subglobose, 2-4 mm. long, greenish-brown, blunt, in a simple to compound panicle of cymules this subtended by several, leaflike involucrel bracts, the longest exceeding the inflorescence. Fertile bracts lanceolate or oblong, thin and stramineous, save for a prominent, broad, greenish midrib, this exerted as an elongate ascending to somewhat recurved cusp. Stamens 1, the anthers 0.2 mm. long. Style 2-branched, about the length of the akene or slightly longer, subterete, the base not swollen, the surface smooth. Akene oblong, slightly curvate, terete, 0.4-0.6 mm. long, pale brown with some iridescent tints, finely reticulate, the reticule made up of about 12 vertical rows of many narrowly rectangular slightly concave horizontal cells, the longitudinal lines more prominent than the horizontal.

Alluvium of borders of pineland ponds, Sumter and Seminole counties Georgia.

Type: U. S. A. GEORGIA. SUMTER CO.: prostrate on muddy bottom of exsiccated pine barren pond near Leslie, *R. M. Harper 1729*. Holotype at NY, examined by writer.

Taxonomically, this species could be confused in northern America only with *F. vahlii*, but differs from it in its more open inflorescence and in its narrower, banana-shaped, fruit. It bears a striking resemblance to the Asian *F. dipsacea*, differing from it only in its more ascending-tipped fertile scales and in the lack of bladder-like projections of pericarp (see figure 42B). One can see from a comparison of specimens of the two that they are un-

doubtedly very closely related, if not conspecific. From the standpoint of plant geography this may be a more interesting consideration than if indeed *F. perpusilla* is a distinct species. *F. perpusilla* is also similar in its fruit to *F. stauntoni* Debeaux and Franchet ex Debeaux (see figure 42C) but differs from that species in its lower stature, fewer and much shorter style branches, and in its lack of a ligule.

As might be inferred from the statement of range given above, *F. perpusilla* is the rarest North American *Fimbristylis*, being known only from two localities in Georgia. It is quite diminutive, hence has probably been often overlooked by collectors. My own encounter with it was purely accidental. Whilst looking for *Xyris* in southwestern Georgia I came across a virtual "fuzz" of small sedge carpeting the drying margins of a small pineland pond (Georgia, Seminole Co.: 1.5 mi. e. Donaldsonville; sandy clay of cypress-pond pine flatwoods; mucky pond margin, (12 Aug. 1962, R. Kral 15486). It is so unlike any other North American *Fimbristylis* in appearance that I did not even record it as such in my field notes. On returning to the herbarium at F. S. U. I discovered the odd "banana" shaped akenes that could only be the fruit of *F. perpusilla*. According to Small (1933) the plant had been known only from the type locality. Harper, discoverer and namer of the species, had also described it as carpeting a pineland pond bank. This was in 1903, and as I understand it subsequent visits to the same habitat in later years were all unproductive. Dr. Godfrey returned to the Seminole County locality a year later to find but a few plants; my own visits during following years have been to no avail.

It is noteworthy that *F. perpusilla* can develop in such numbers on a particular year, yet virtually disappear the next. It would seem that the sporadic appearance of this species must have to be based on an inherent capacity for long periods of dormancy. Conditions for its germination must involve first a fine textured substratum such as would be exposed by retreating silty water, and secondly that this neither be dried out nor on the other hand covered by advancing water during the time of establishment of the seedlings. In the Coastal Plain, which has frequent summer rains, these conditions are seldom met.

43. FIMBRISTYLIS SPATHACEA Roth, Nov. Pl. Sp. 24. 1821.

Scirpus glomeratus Retz., Obs. 4: 11. 1786. Not *S. glomeratus* L. 1753.

Scirpus obtusifolius Vahl, Enum, 2: 275. 1805.

Fimbristylis obtusifolia (Vahl) Kunth, Enum. Pl. 2: 240. 1837.

Fimbristylis sintenisii Boeck., Bot. Jahrb. 7: 276. 1886.

Fimbristylis glomerata (Retz.) Urban, Symb. Ant. 2: 166. 1900. Not *F. glomerata* Nees, 1834.

Fimbristylis melanospora Fernald, Proc. Am. Acad. 36: 491. 1901.

Solitary or tufted, hard-based, glabrous perennial to 5 (rarely 7) dm. tall with stiffly spreading leaves and rigidly erect or ascending culms, the culms bases sheathed by dark, stiff, remnants of old leaf bases. Leaves firm, thick, about half as long as the scapes or even shorter, the blades

linear, 1-4 mm. broad, spreading or recurved, flat to somewhat involute, gray-green, the nerves of the back raised, often one particularly prominent and giving a double-edged appearance to one margin, the margin itself distantly scabrid; sheaths rigid, broad, thick, clasping, pale-green but aging to dark brown, with a broad, thin, usually entire margin this abruptly converging to the blade. Ligule absent. Scapes stiff, usually erect, subterete, the ridges several and fairly prominent. Longest involucrel bract shorter than the inflorescence. Spikelets ovoid, 2-3 mm. long, acute to blunt, greenish, brown, or yellow-brown, very many in a dense, often hemispherical, usually head-like, sometimes open aggregation of subsessile to pedunculate cymules. Fertile scales ovate, slightly keeled, entire, obtuse to emarginate, stramineous to brown save for a broad scarious margin and a thicker, usually paler, zone of midrib, this not excurrent. Stamens usually 1, anthers ca. 0.3 mm. long. Style 2-branched, (the branches longer than the base) somewhat 2-edged, not fimbriate. Akene about 1 mm. long, obovoid, usually tumid, rarely obscurely angled in cross section, the surface pale brown, brown or very dark brown (almost blackish), cancellate or distinctly or indistinctly reticulate, and in addition often verrucose. Pedicel joint not persisting on akene.

Moist to rather dry, brackish sands or estuarine deposits, coastal dunes, beaches, edges of brackish marshes, in the United States only in peninsular Florida and the Keys, in North America throughout the Caribbean and along both the Atlantic and Pacific shores of the continent from northern Mexico south. Found in both Old and New World tropics.

Type locality: India. Type not examined by this writer.

This species, with its thick, rigidly spreading rosette of leaves, its thick stiff scapes terminating in dense clusters of small spikelets the scales of which have broad, scarious margins, is so unlike any other North American species that no great problem in identification exists. However, *F. spathacea* is treated by Koyama (1964) as *F. cymosa* R. Br., a plant of the Pacific island and Australasia. However, that plant was described by Robert Brown as having 3 style branches, and the akenes of specimens of *F. cymosa* I have examined (admittedly few) show at least an obscurely trigonous design (see plate 43b). While in Cyperaceae the number of style branches is not a generic character it still constitutes an important specific character.

F. spathacea appears to be a rather recent introduction into the United States. There is no mention of it in Small's Manual; some of the first collections of it from the U. S. were made by Killip in the 1930's, these from very southern Florida. However, now that it is here, it appears quickly to be occupying alkaline situations along beaches and road shoulders in peninsular Florida. Its spread further north may be controlled by temperature in that the plants have their heaviest flowering and fruiting during the winter months. This may be just as well, for in the greenhouse it is a full fledged, very aggressive weed.

44. *FIMBRISTYLIS argillicola* Kral, sp. nov.

Perennis caespitosa usque 1 m. alta, culmis basi bulbosis cum foliis exterioribus squamiformibus. Folia propria plantam 1/3-2/3 aequantia, laminis anguste linearibus (ad 1 mm. latis) laevibus (marginibus ciliato-scabridis exceptis). Spiculae lanceol-ovoideae vel ellipsoideae castaleae vel brunneae (vivo atratae). Achaenia lenticulari-obovoidea vel obpyriformia ca. 1.5 mm. longa.

Caespitose perennial, erect or ascending at most to 1 meter tall, the bases of the culms bulbous, the outer leaves of a clump scale-like. Leaves 1/3-2/3 the length of the plant, the blades narrowly linear (rarely exceeding 1 mm.), involute, smoothish, pale green, the nerves of the lower surface numerous and raised, the margin pale, thickened, upwardly ciliate-scabrid, at least toward the base and apex; sheathing portion of the leaf broad, smooth, stramineous to dark brown, thickened, but with a pale brown scarious margin, this entire, its apex passing into the blade at an acute angle. Ligule of hairs absent. Scapes slender, little wider than leaves, multicostate, smooth, subterete below, somewhat flattened toward the apex. Longest bract of the involucre shorter than the inflorescence, the blade similar in character to that of leaves. Spikelets lance-ovoid, or ellipsoidal, 0.7-1.2 cm. long, (1-) 3-5 (-7), all but the central one in an open umbellate system of ascending peduncles, castaneous to dull brown. Fertile bracts broadly ovate, entire smooth, or with a few short hairs apically around the midrib, the midrib itself paler, either pale green or stramineous, this usually exerted as a short cusp. Stamens usually 2, rarely 3, the anthers 1.5-2.0 mm. long, apiculate, the filaments broad and flattened, but narrowing apically at point of attachment with anthers. Style 2-branched, flattened, fimbriate from at least its midpoint to the point of branching. Akene lenticular-obovoid, or obpyriform about 1.5 mm. long, a pale to deep brown, rather finely scalariform-foveate or reticulate, the individual cells horizontally rectangular, arranged in numerous, vertical lines; surface of akene usually verrucose. Joint of akene short, usually persistent on fruit.

Type: MEXICO. MICHOACAN. Just west of Puente Rio de Turundeo, w. of Tuxpan on heavy wet soil of boggy swale in relict prairie by highway 15, R. Kral 25509. Holotype at MICH.

Moist to rather dry, often somewhat brackish, heavy soils of original grasslands, Mexico, in the states of Guerrero, Mexico, D. F., Jalisco, Michoacan, Durango, Zacatecas, Aguascalientes, Puebla, Guanajuato. Particularly abundant in the lake country of Jalisco.

This species has often been identified as *F. pentastachya* Boeck. the type locality of which is in the state of Vera Cruz, a state in which this plant does not seem to occur. It differs from *F. pentastachya* by its smoother foliage, its darker coloured spikelets, and in the character of its old leaf bases which is not fibrous-shreddy. *F. pentastachya* has much paler, reddish brown spikelets, and is well marked by the fibrous character of its old leaf bases. While *F. pentastachya* is a plant of savanna development in oak or

oak-pine forest, *F. agrillicola* is definitely a plant of native grassland. The former is a plant of rather loose textured soils, while the latter grows on heavy black gumbo-type clay.

The best growth of *F. argillicola* is on alkaline soils. In the lake country around Guadalajara it is frequent in association with brackish soil plants. In the greenhouse it responds best to fine-texture, alkaline or circumneutral, potting medium. Flowering plants may be grown from seed in a few months. As is the case with *Abildgaardia*, the seedlings quickly develop numbers of close-set and bulbous-based lateral offshoots. Flowering scapes usually do not form until rosettes of such offshoots are well developed.

45. FIMBRISTYLIS PENTASTACHYA Boeck., Flora 40: 36. 1857.

Perennial to 1 meter tall, the culms bulbous-based, solitary or in small tufts, usually also with bases invested in a fibrous ramentum of old leaf bases. Leaves 1/2-3/4 the length of the mature scapes, spreading-recurved, lax, the blades linear, flat to somewhat involute, with several prominent ribs on the backs and two marginal ribs, the margins ciliate, particularly toward the apex and base of the blade, with pale, stout and rather long, ascending or upwardly appressed, trichomes, the upper and lower surfaces similarly pubescent toward the base of the blade; sheaths broad at the base, the old sheaths becoming fibrous, a deep reddish-brown, the margins subscarios, pubescent on the backs, and tapering gradually or abruptly to the blade, here copiously pubescent with pale, crisped trichomes. Ligule not evident. Scapes about the width of the leaf blades, rather lax, subterete and multicarinate below, many-ribbed and somewhat flattened distally, smooth. Longest bract of the inflorescence similar in texture and indument to leaves, somewhat shorter than to longer than the inflorescence. Mature spikes ovoid to ellipsoidal, acute, ca. 1 cm. long, 3-7 (usually 5), all but the central ones pedunculate in open simple umbell-like cymes, the individual peduncles ascending, to 4 cm. long. Fertile scales ovate, smooth, reddish-brown save for a paler, scarios edge and a paler or sometimes greenish midrib, rounded or obtusely angled, the margin entire or ciliate apically. Midrib of 5, often conspicuous, close-set nerves, this exerted as a short mucro on the lower scales, otherwise included. Stamens 3, anthers about 3 mm. long. Styles 2-branched, the edges fimbriate above the mid-point and to the bases of the style branches. Akene lenticular-obovoid, 1.5-2.0 mm. long, brown, rather flat to somewhat tumid, the surface reticulate, the cells broadly or narrowly rectangular, horizontal, in several longitudinal lines, the surface irregularly dotted with pale, dome-like or irregularly shaped warts.

Red, sandy-clay soils of pine or oak-pine savannas, lower elevations in both the Sierra Madre Oriental and Occidental of Mexico in the states of Guerrero, Jalisco, Michoacan, Oaxaca, Veracruz.

Type locality: Veracruz, Mexico ("ex hb. Schultzii Bip."). The identification of *F. pentastachya* has to be based upon the type description rendered by O. Boeckeler (1860) in that the actual specimen (or specimens) was de-

stroyed by fire during the Second World War. Therefore I designate the following specimen as neotype: MEXICO. VERACRUZ. Zacuapan and vicinity, C. A. Purpus 2405; at US.

This *Fimbristylis* is not infrequent in the Mexican mountains, particularly in burned-over areas or savanna formations. It appears to be closest to *F. puberula* (Michx.) Vahl, but has very different fruit which is obpyriform, usually tumid, and which is papillose-tuberculate, a feature not known for that wide-spread United States species. I have as yet been unable to get living material into the United States and have seen the plants only in the vegetative condition.

The name *F. pentastachya* has been applied to another species of the Mexican high plateau; this latter grows only in the grasslands, often in fairly brackish situations, and is distinguished by its smoother foliage, its very dark (sometimes almost blackish) spikelets, and its tendency to form large tufts of bulbous-based culms. This latter species has been assigned the name *F. argillicola*, after the heavy clay earths of its habitat.

46. **FIMBRISTYLIS pallidula** Kral, sp. nov.

Perennis dense caespitosa usque 1 m. alta (plerumque humilior). Glumae fertiles lato-ovatae integrae glabrae flavescentes ad pallido-brunneae juxta costam pallidiores. Achaenia lenticulari-obovoidea ca. 1.5 mm. longa pallido-brunnea.

Densely caespitose, glabrous, perennial to 1 meter tall (usually lower), the culm bases invested by long, castaneous, leaf bases, the plant base deeply set in the substrate. Leaves from 1/3 the length of the scapes to nearly equalling them, gray-green, the blades linear, about 1 mm. broad fleshy, involute, the backs not prominently nerved, the margins somewhat thickened and ciliate-scabrid at least toward the sheath and tip; sheaths broad, glabrous, aging to dark brown, with a scarious, often broad margin, this rounded or forming an acute angle with the blade, its margin usually ciliate at this point. Ligule absent or incomplete. Scape slender, somewhat broader than the leaf blades rather rigid, somewhat channelled, subterete throughout, or slightly compressed upwardly toward the inflorescence. Spikelets ellipsoidal or lance-ovoid, a pale brown, 5-8 mm. long, acute, few to many on ascending, flattened branches, in a compound panicle of cymules. Longest bract of the involucre somewhat shorter than to much exceeding the inflorescence, the blade somewhat flatter than that of the leaves. Fertile scales broadly ovate, entire, glabrous, flavescent to pale brown, the region of the midrib even paler, the midrib exerted as a short cusp. Stamens 3, the anthers ca. 2 mm. long. Style 2-branched, flattened from the base to the point of branching, the edges conspicuously fimbriate from about mid-style to point of branching. Akene lenticular-obovoid to obpyriform, about 1.5 mm. long, pale brown, foveate, the cells almost isodiametric or horizontally rectangular, usually arranged in many fine, vertical lines separated by conspicuous longitudinal ridges. Akene joint (pedicel) short, persistent.

Edges of salt marshes or brackish situations slightly inland, the Pacific coast of Mexico in the states of Sinaloa, Jalisco, Oaxaca, Chiapas.

Type: MEXICO. OAXACA. garbage dump of Salina Cruz, *R. Kral 25312*. Holotype at MICH.

This species is in the same complex as *F. castanea* and *F. spadicea*. It too is densely caespitose, with slender, hard, narrow leaf blades whose bases are usually castaneous; like those species, it also frequents brackish habitats. However, it is a consistently lower plant with consistently smaller, paler spikelets. The pale character of the foliage is also in contrast. I know of no instances of *F. castanea* along the Pacific coast of Mexico, nor are there many examples of *F. spadicea* from that coast line. The chromosome complement of the three is the same, namely N equalling 10.

47. FIMBRISTYLIS SPADICEA (L.) Vahl, Enum. 2: 294. 1805.

Scirpus spadiceus L, Sp. Pl. 51. 1753.

Scirpus domingensis Pers., Syn. Pl. 1: 67. 1805.

Fimbristylis speciosa Rhode: Spreng., Pug. 1: 5. 1813.

Fimbristylis spadicea f. *domingensis* (Pers.) Kuekenth., Repert. Sp. Nov. 23: 196. 1926.

Densely caespitose perennial, often to 2m. tall, the bases castaneous, deep-set in substratum, the outer leaves of a tuft often persistent as scales. Leaves 1/3 to 2/3 the length of the plant, the blades usually very narrowly linear (rarely to 2 mm.) ascending involute, (at least toward base), smoothish, thick, the marginal nerves ciliate-scabrid with stout-based hairs. Sheathing portion of the leaf broad, smooth, a deep and lustrous brown, and with a paler brown or reddish-brown, thin margin, which is entire save for the truncate-ciliate apex. Ligule of hairs absent or incomplete (usually there is a sharp change in colour on the upper surface at the level of the collar). Scapes slender, wand-like, as wide as the blades or somewhat wider, terete toward the base of the plant, subterete or oval in the cross section just below the inflorescence. Spikelets narrowly elliptical, lance-ovoid, or oblong, about 1-1.5 cm. long (in older spikelets much longer lengths are attained, but that part of the rachis bearing scales remains of about the same length) castaneous to pale reddish brown, in an open or somewhat contracted paniculate system of cymes. Longest bract of the involucre with a flat blade sometimes equalling the inflorescence but very often exceeding it. Fertile bracts broadly ovate, smooth, castaneous, brown or reddish-brown save for the pale areas along the midrib, the apex obtuse, the margin pale, entire and sub-scarious; veins of the mid-portion of the scale hardly distinguishable from the other veins, but excurrent as a short mucro. Stamens 2 or 3, the anthers about 2 mm. long. Style 2-branched, flattened, fimbriate from the base to the point of branching. Akene lenticular-obovoid, or obpyriform 1.5-2.0 mm. long, a pale to deep brown, scalariform-foveate or reticulate, the individual depressions almost isodiametric or horizontally rectangular, usually arranged in fine, vertical lines. Base of akene jointed to spikelet by means of a short joint, this usually breaking off with the fruit.

Type locality: Jamaica "In Jamaicae fluviis." Based on figure in Sloane, Hist. Jam. pl. 76.

In North America confined to the coastal marshes of the Caribbean Islands and Mexico. A common salt-marsh sedge along the Atlantic in both Central and South America.

I treat this species as distinct from *F. castanea* (Michx.) Vahl in that it usually has narrower spikelets in more diffuse inflorescence together with a more robust habit. Admittedly the two entities are quite similar in many respects and it is therefore a strong temptation to treat them as conspecific. However, my mind was changed as a result of a trip to Mexico via the gulf coast of Texas. The plants of the Texas coast are not much different than those of the coasts of the other Gulf and Atlantic states. In the state of Tamaulipas, Mexico, plants of vastly different appearance are to be seen along the coast in similar habitat to that occupied by *F. castanea* in the U. S. These are, on the average, much taller, with a more reddish quality to the living spikelets and with much narrower (often smaller) spikelets in much larger and more diffuse inflorescences. This sort of plant is continuous along the Atlantic coast of Mexico until one reaches the Yucatan peninsula, where (at the tip of Yucatan) stands of the "castanea" type again appear. Both types cohabit coastal areas of the Bahamas and of Cuba. I am faced with the sort of situation that is clear in the field, yet hard to demonstrate on the basis of herbarium specimens. As Svenson has stated, all the "spadicea" complex have very similar akenes (this complex includes taxa here treated as *F. caroliniana*, *F. puberula*, *F. castanea*, *F. inaguensis*, *F. thermalis* in addition to *F. spadicea*).

48. FIMBRISTYLIS CASTANEA (Michx.) Vahl, Enum. 2: 292. 1805.

Scirpus castaneus Michx., Fl. Bor.-Am. 1: 31. 1803.

Fimbristylis cylindricum Vahl, Enum. 2: 293. 1805.

Fimbristylis spadicea (L.) Vahl var. *castanea* (Michx.) A Gray, Man. ed. 5. 566. 1867.

Densely caespitose perennial to 1.5 (-2.0) m. tall, the bases of the plant castaneous, deep set in substratum, the outer leaves of a tuft and the older leaves persistent as imbricated scales. Leaves from 1/3 the length of the culms to nearly as long, the blades usually very narrowly linear (rarely to 2 or 3 mm. broad), ascending, thick (often semicircular in cross section), most frequently involute, smooth, particularly toward the base, the nerves on the back numerous and indistinct, but the marginal nerve or nerves ciliate scabrid with ascending, stout-based, hairs, sheathing portion of the leaf broad, (broadening gradually toward the base) a pale brown, dark brown or very deep lustrous reddish-brown, thick and rigid, the margin broad, thin or even scarious, entire save for the truncate or rounded, ciliate apex. Ligule of hairs either absent or incomplete, but a colour change evident on the upper surface of the leaf at the collar. Scapes slender, wand-like, as wide as the blades or somewhat wider, many-ribbed, terete toward the base of the plant, subterete, oval, or elliptical in the cross section up-

wardly. Longest bract of the involucre usually shorter than the inflorescence or about the length of the inflorescence (rarely longer), the blade somewhat flattened, ciliate-scabrid. Spikelets usually ovoid or lance-ovoid, very rarely cylindrical, 0.5-1.0 cm. long, rarely longer, the mature ones usually pale to dark brown, dull, in a dense to open ascending or spreading umbellate compound system of cymes. Fertile bracts broadly ovate, smooth, brown, usually dull, the margin entire or becoming erose with age, the apex rounded; veins of the mid-portion of the scale obscure, or visible as faint pale lines, these, converging apically to form a short mucro. Stamens 2 or 3, the anthers about 2 mm. long. Style 2-branched, flattened, fimbriate from the base to the point of branching. Akene lenticular-obovoid or obpyriform, 1.5-2.0 mm. long, reddish-brown or dark brown, often lustrous, scalariform-foveate or reticulate, the individual cells almost isodiametric or horizontally rectangular, usually arranged in numerous, fine, vertical rows.

Type locality: "Florida." (Herbarium Richard, at P).

Moist sands or muck of coastal marshes, duneswales, or estuary banks (rarely alkaline situations inland), Long Island south along the Atlantic coast into the Florida Keys, and along the Gulf Coast south and west into Mexico (Tamaulipas); Yucatan peninsula; the Bahamas; Cuba.

Fimbristylis castanea is invariably found in brackish marsh and, save in the state of Florida, seems never to be found far from the existing sea-coast. Along the Atlantic coast in the southeastern and Gulf United States it may be found in proximity to two other perennial species, *F. caroliniana* and *F. puberula*. It may be distinguished from both by being caespitose rather than rhizomatous (*F. caroliniana* produces slender rhizomes while *F. puberula* produces thick, knotty rhizomes or more rarely slender rhizomes in addition). It is also to be distinguished on the basis of habitat, being a true denizen of brackish marsh, while *F. caroliniana* is usually in drier or less alkaline situations and *F. puberula* in turn frequents more acid habitats inland. Occasionally, where there has been much mechanical disturbance of coastal areas where the habitats of all three are contiguous, one may find all three growing together on the freshly disturbed surface.

F. castanea and *F. spadicea* overlap in the Bahamas, Cuba and parts of Mexico. However, as fine as the differences are which (in my opinion) distinguish the two, these differences appear to hold (see discussion under *F. spadicea*).

49A. FIMBRISTYLIS PUBERULA (Michx.) Vahl var. PUBERULA, Enum. 2: 292. 1805.

Scirpus puberulus Michx., Fl. Bor. Am. 1: 31. 1803.

Isolepis drummondii Torr. & Hook.: Torr., Ann. Lyc. N. Y. 3: 350. 1836.

Fimbristylis drummondii (Torr. & Hook) Boeck., Flora 41: 603. 1836.

Fimbristylis anomala Boeck., Flora 43: 242. 1860.

Fimbristylis multistriata Boeck., Flora 43: 1860.

Fimbristylis spadicea (L.) Vahl var. *puberula* (Michx.) Chapm., Fl. S. US. 522. 1860.

Fimbristylis puberula var. *drummondii* (Torr. & Hook.) Ward, *Castanea* 33: 132. 1968.

Perennial, the culms solitary or in small tufts, to 1 m. tall, the culm bases often hard, knotty, jointed together into short, thick rhizomes on which the old leaf bases often persist as shreddy remnants (in a few populations of coastal Fla. and Ga. having some slender, pale rhizomes). Leaves from 1/3 as long to nearly equalling the culms, the blades narrowly linear, usually involute at least toward the base, about 1 mm. wide, the backs with several raised nerves, smooth to variously pubescent, the upper surface smooth or variously pubescent, the margin pale, cartilaginous, ciliate-scabrid (this most noticeable toward the blade base and apex). Sheaths hard, thick, fibrous, a pale to dark brown, the margin broad, scarious, entire save for long ciliate at apex. Ligule inconspicuous, incomplete, or absent. Longest bract of inflorescence erect, the blade flattened, usually much surpassed by the inflorescence. Spikelets lance ovoid to ovoid or ellipsoidal, from 0.5-1.0 cm. long, reddish-brown, in a usually few-flowered, compact to open system of pedunculate cymules, or a simple umbel-like cyme. Fertile scales ovate, to obovate or even reniform, reddish-brown, dull-brown or flavescent, the backs rounded, the margin scarious, rounded, entire, ciliate or somewhat lacerate, the nerves inconspicuous, flavescent to pale brown or sometimes the central ones slightly raised, greenish and slightly excurrent as a short mucro; outer surface of at least the lower scales puberulent at least toward the apex. Stamens 3, anthers 2.0-2.5 mm. long. Style 2-branched, flattened the edges usually fimbriate from about the mid-point to the base of the style branches. Akene lenticular-obovoid, about 1 mm. long, rather flat to somewhat tumid, sometimes umbonate, flavescent to dark brown, the surface distinctly to faintly reticulate, the cells rectangular, usually arranged in several longitudinal lines (11-20 on a face) in a few cases with very many longitudinal lines with the cells isodiametric, the longitudinal lines prominently to slightly raised.

Sands, sandy peats, or clays of savannas, open pinelands, upper edges of grass-sedge bogs, meadows, and prairies, throughout the Atlantic and Gulf coastal plain from Long Island south into peninsular Florida and west in Texas nearly to the Mexican border; scattered from the central Piedmont to its southwestern edge; scattered in the interior highlands and of frequent occurrence in the moist meadows and prairies of the central lowlands, particularly along the Great Lakes on the Pleistocene shores and west into the tall and mid-grass prairies of Texas, Oklahoma, Kansas, and Nebraska. Canada ("Lambton Co.: Squirrel Island, one of delta islands of St. Clair River, near Lake St. Clair, C. K. Dodge, 26 Jun 1904").

Type locality: Georgia and Carolina. Two specimens of the Michaux material, obligingly lent me by Dr. A. Lourteig at P, and both identified as "*Scirpus puberulus*" are interesting in that they show the range of foliar vestiture, one having dense puberulence of the leaves and scape, the other being smooth-leaved and scaped. However both are distinguishable from *F.*

caroliniana (Lam.) Fern. by their subterete scapes and narrow, eligulate foliage.

49B. FIMBRISTYLIS PUBERULA (Michx.) Vahl. var. **interior** (Britton) Kral, comb. nov.

Fimbristylis interior Britton, in Britt. & Brown, Ill. Fl. ed. 2. 1: 320. 1913.

As the species but plant base less bulbous, and producing dense clusters of short, slender, twisted, pale reddish-brown rhizomes. Foliage pale green, sometimes appearing glaucous, the blade margins distantly to approximately ciliate-scabrid. Ligule inconspicuous or present as a narrow line of short, ascending hairs. Longest involucral bract usually longer than the inflorescence. Spikelets ovoid, cylindrical, or ellipsoidal, 0.5-1.0 cm. long, stramineous to reddish-brown, the backs of the scales usually smooth, the central nerve of at least the lower scales excurrent as a definite terete mucro. Akene with several prominent to rather obscure longitudinal ridges, these interconnected with finer horizontal lines, hence the surface made up of longitudinal rows of roughly idodiametric, shallowly concave cells.

Sandy sloughs in prairie and along major river systems, prairie provinces, particularly in western Kansas and Nebraska, but extending south into western Texas and southwest into Arizona.

Type locality: Colorado, Logan Co.: Starling, G. E. Osterhout, 13 Aug 1896 (NY).

Fimbristylis puberula is perhaps the most widespread species of the genus in North America. It is found in prairie swales of the plains country as well as in acid sandy oak or pine barrens of the forested east. It is not unusual in perennial grass-sedge formations about sandy lakeshores. It particularly abounds in the lower sandy (Pleistocene) terraces of the Atlantic and Gulf coastal plains, especially in pine flatwoods and savannas, where its thickened rhizomes give it some advantage in such fire-controlled formations.

The central morphology of the species is actually a smoothish, type lacking slender rhizomes which is widely distributed through the central prairie provinces of the U. S. A. or in savannas eastward. However, several other forms appear in the coastal plain, some extremely difficult to distinguish from *F. caroliniana*. A field appraisal reveals the following sorts: (1.) a puberulent, bulbous-based form of acid pinelands, bogs and savannas, which is the same as one of the Michaux specimens and which is easily distinguished from the usually glabrous-leaved. *F. caroliniana* (see my numbers 15272, 15437, 17912, 17924, 18001, 19312, 20488, 22951, 22970, 24109, 27107, 27066, 27120, 27156, 27144, 27166, 27179): this form is most abundant in peninsular and northeastern Florida but is occasional north into eastern North Carolina and west into southern Mississippi. (2.) an otherwise similar, but smooth-leaved form of similar habitat and which is often in mixed populations with no. 1; it is indistinguishable from populations from the prairie provinces of interior U. S. A. (see numbers 17867, 17894, 17956, 18260, 18419,

18451, 18470, 19374, 20106, 20155, 20165, 20173, 21996, 22089, 22268, 22319, 23041, 24173, 21996, 22089, 22268, 22319, 23041, 24173, 25795, 25822, 26872, 27114, etc.): (3.) a frequently rhizomatous, smooth or hairy plant of areas near the coast in peninsular Florida, Georgia, North Carolina, and Virginia which appears intermediate between *F. caroliniana* and *F. puberula*, (see numbers 15329, 18359, 18369, 18400, 22861, 22909): such forms always occur in broad, only slightly acid marshes such as those which develop along the St. Johns River in Brevard County or between the present east coast of Florida and the acid pinelands that develop inland. In the latter areas there are almost invariably large populations of knotty-based *F. puberula*. In the former situations, usually in duneswales or at the upper edges of salt marshes, are usually stands of robust *F. caroliniana*. The plants of the ecotone, and which I am designating at least in part as *F. puberula* are *puberula*-like in all respects save that they produce slender rhizomes. All chromosome counts of the robust, coastal forms of *F. caroliniana* (treated by Small as *F. harperi*) have haploid chromosome complements of 30; all counts of *F. puberula* taken thus far show a haploid complement of 10 or less commonly 20. A genetic connection between all three sorts of populations is perhaps possible, perhaps through a failure at meiosis of *puberula* types (haploid of 10) to reduce their chromosome numbers and some of these fertilising or being fertilised to form hexaploid *F. caroliniana*. A solution to this problem remains to be worked out.

The western part of the range of *F. puberula*, beginning in western Texas, eastern Nebraska and Kansas, is occupied by the variety *interior* (see numbers 28872, 28879, 28923, 28927, 28955, 28963). The most striking characteristic of this entity is its production of numerous, very slender, twisted orangish rhizomes which arise from a base that is usually not thickened as it is in *F. puberula* var. *puberula*. The longest bract of the inflorescence of these plants usually surpasses the inflorescence, and the scales of the spikelets are smoothish. Britton (l.c.) treated it as a species, but its great resemblance to *F. puberula* in all other respects than those mentioned above have led me to consider it a variety of that species. The varieties are sympatric in Nebraska and Kansas and Texas, only *F. puberula* var. *puberula* being found to the east of this longitude. However, it would seem that the two varieties are fairly well isolated even where their ranges overlap. The variety *puberula* is usually through flowering by early summer, which is the time the variety *interior* begins to flower.

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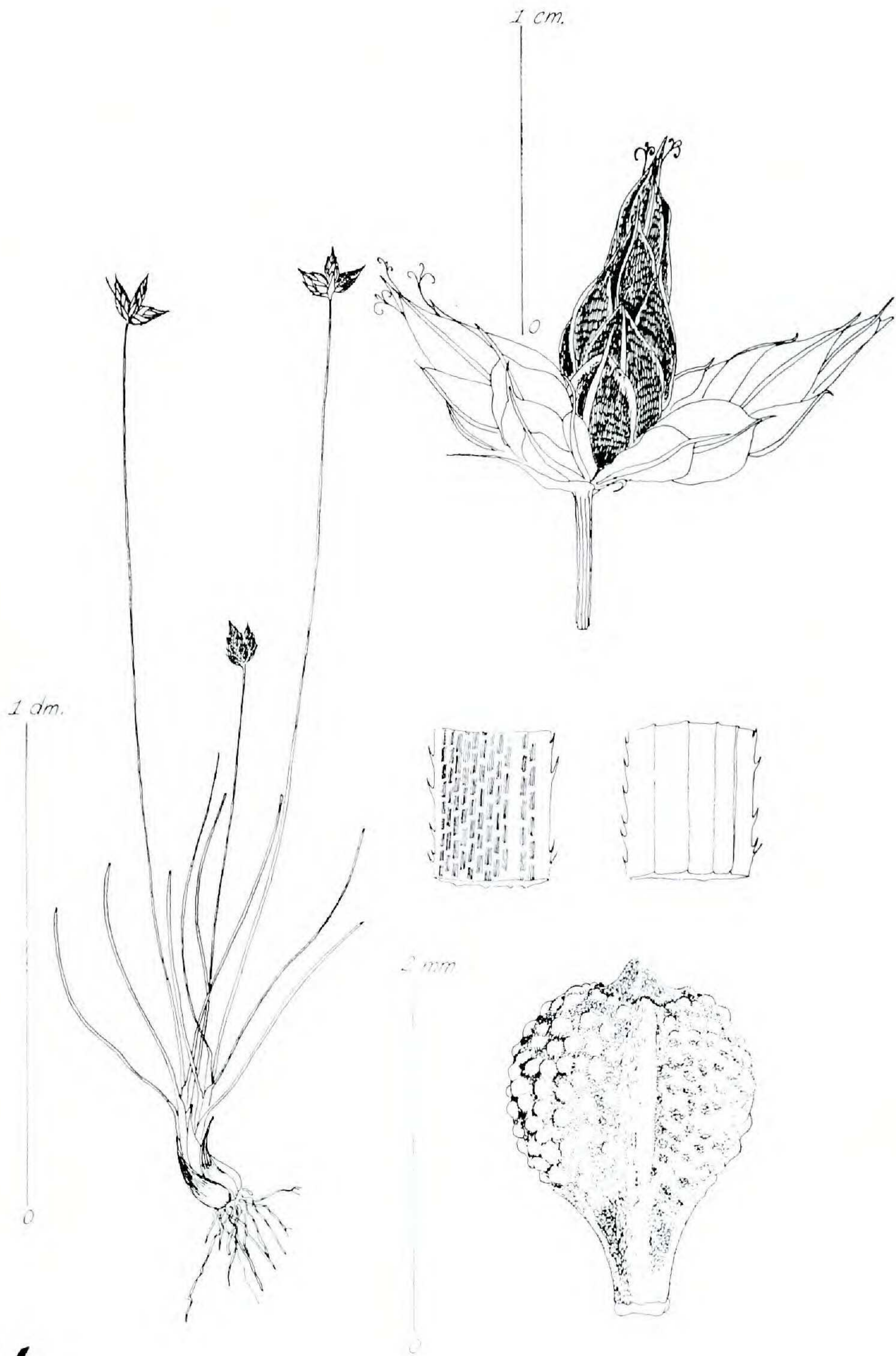
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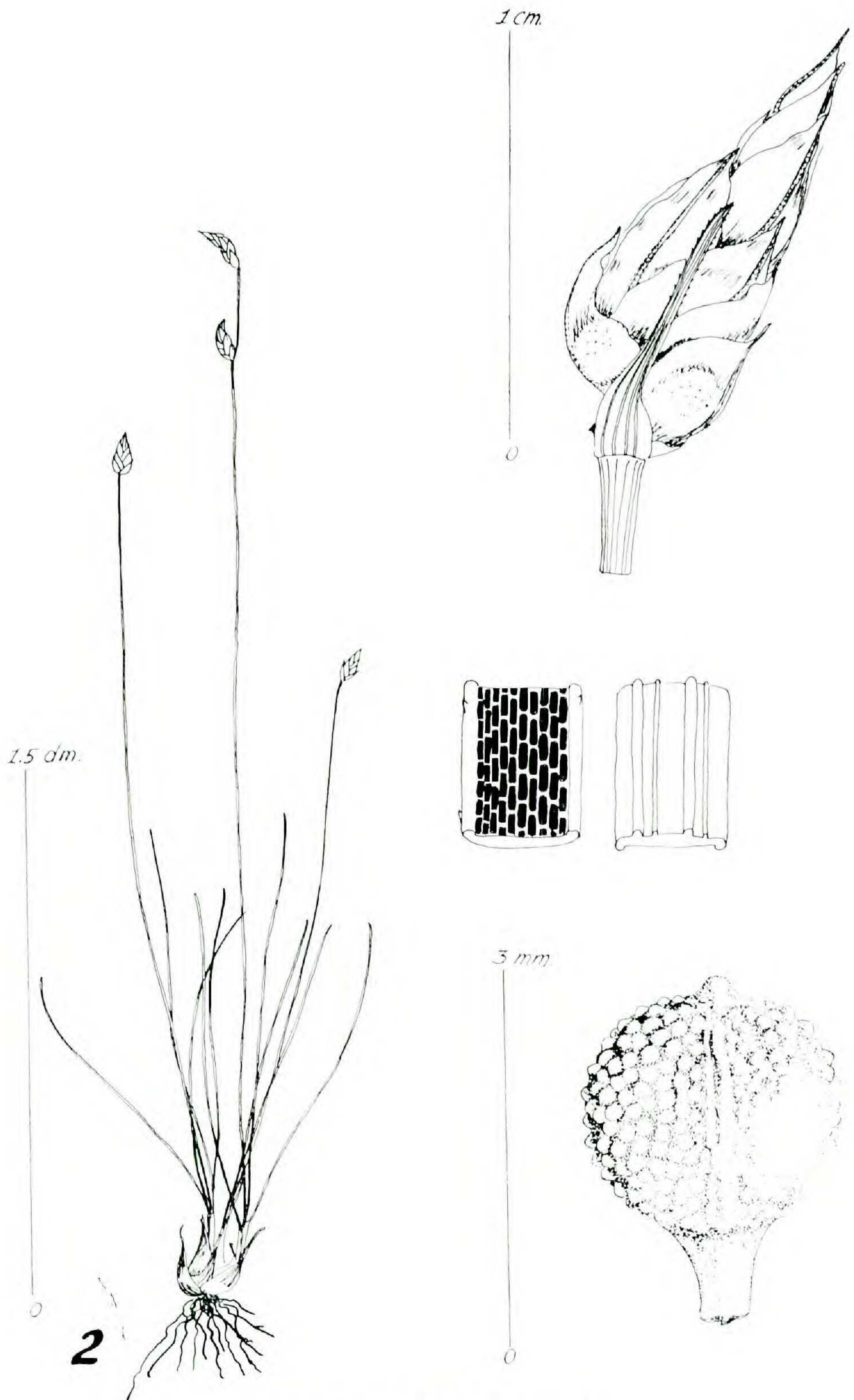
ILLUSTRATIONS

These are numbered to correspond with text treatment. Each plate shows a whole plant reduced, with enlarged details of spikelets and achene, and in most cases of a principal leaf sheath. Plates 33b. *Fimbristylis polytrichoides*, 33c. *F. tristachya*, 37b. *F. bisumbellata*, 40b. *F. aestivalis*, 42b. *F. dipsacea*, 42c. *F. stauntoni*, and 43b. *F. cymosa* are for purposes of comparison only; these species are extra-limital and not fully treated in the text.

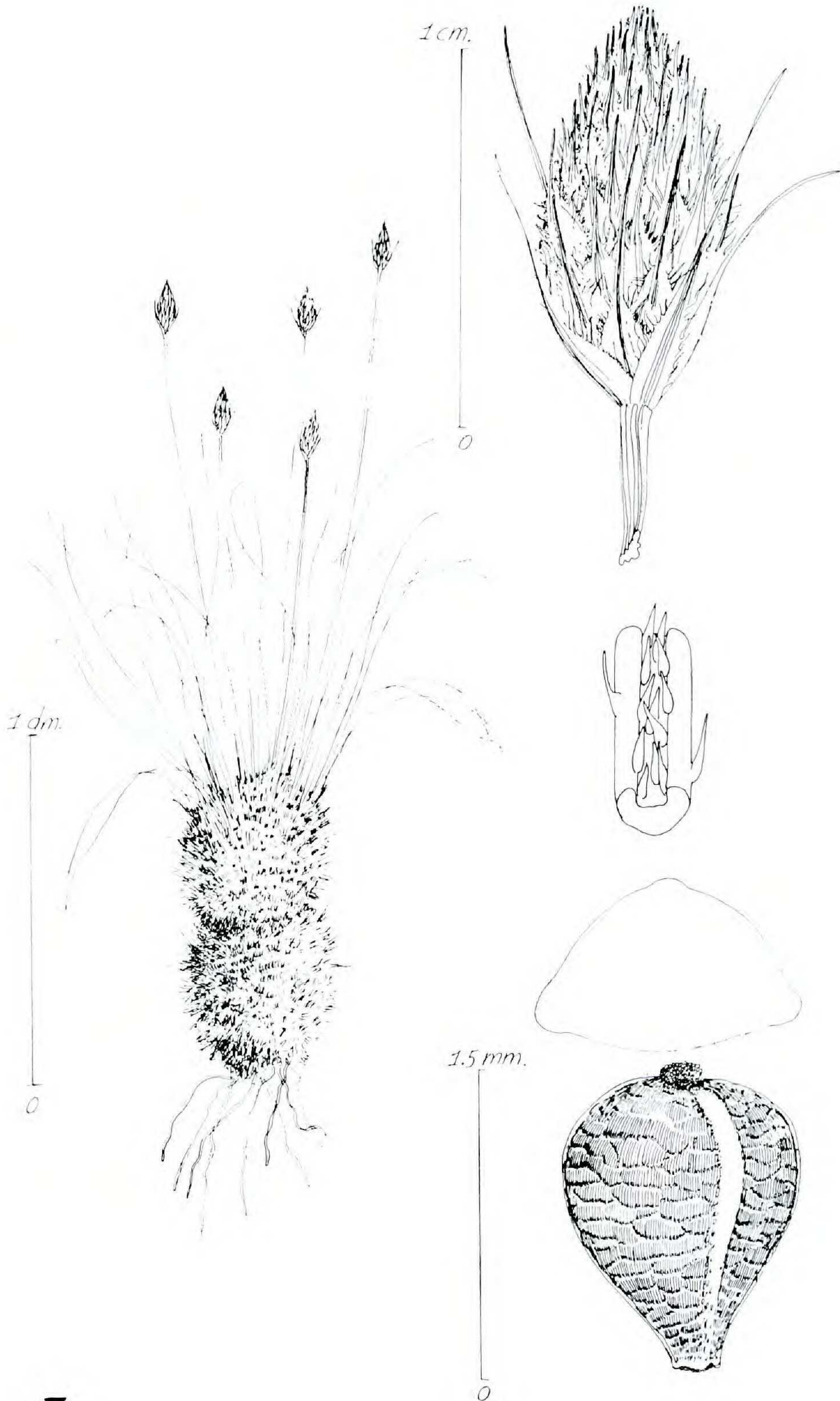
All illustrations are by the author.



1. ABILDGAARDIA MEXICANA

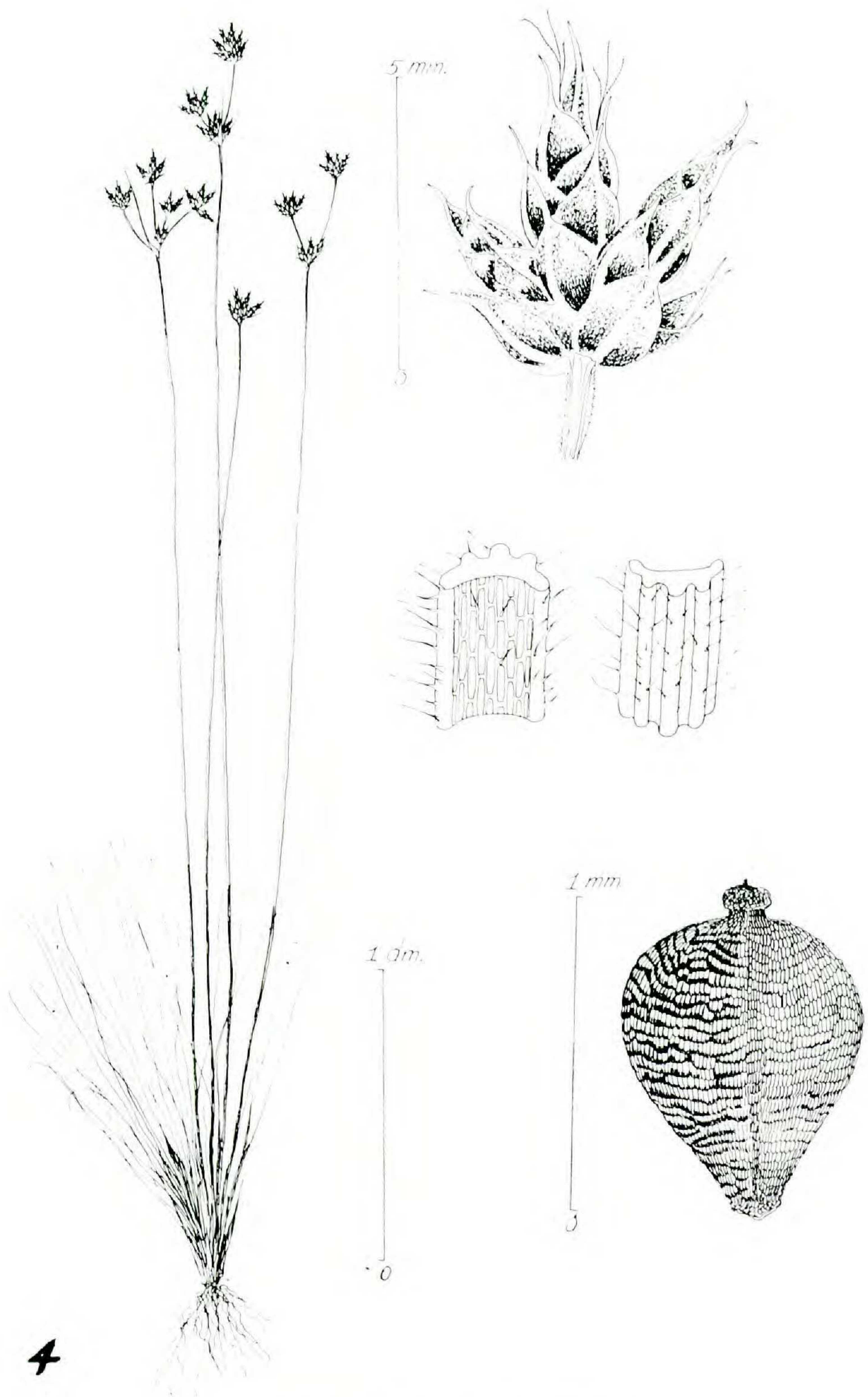


2. ABILDGAARDIA OVATA

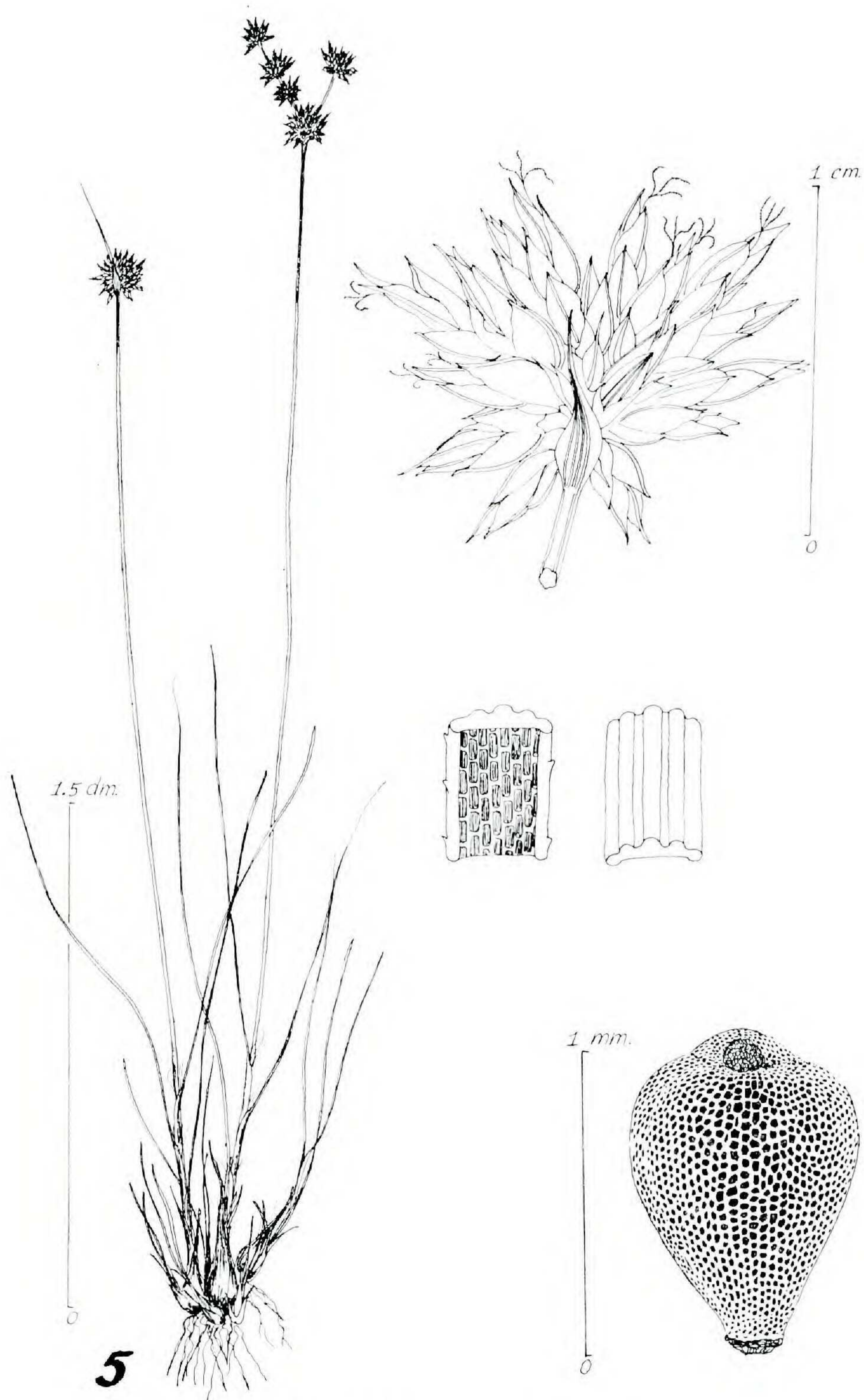


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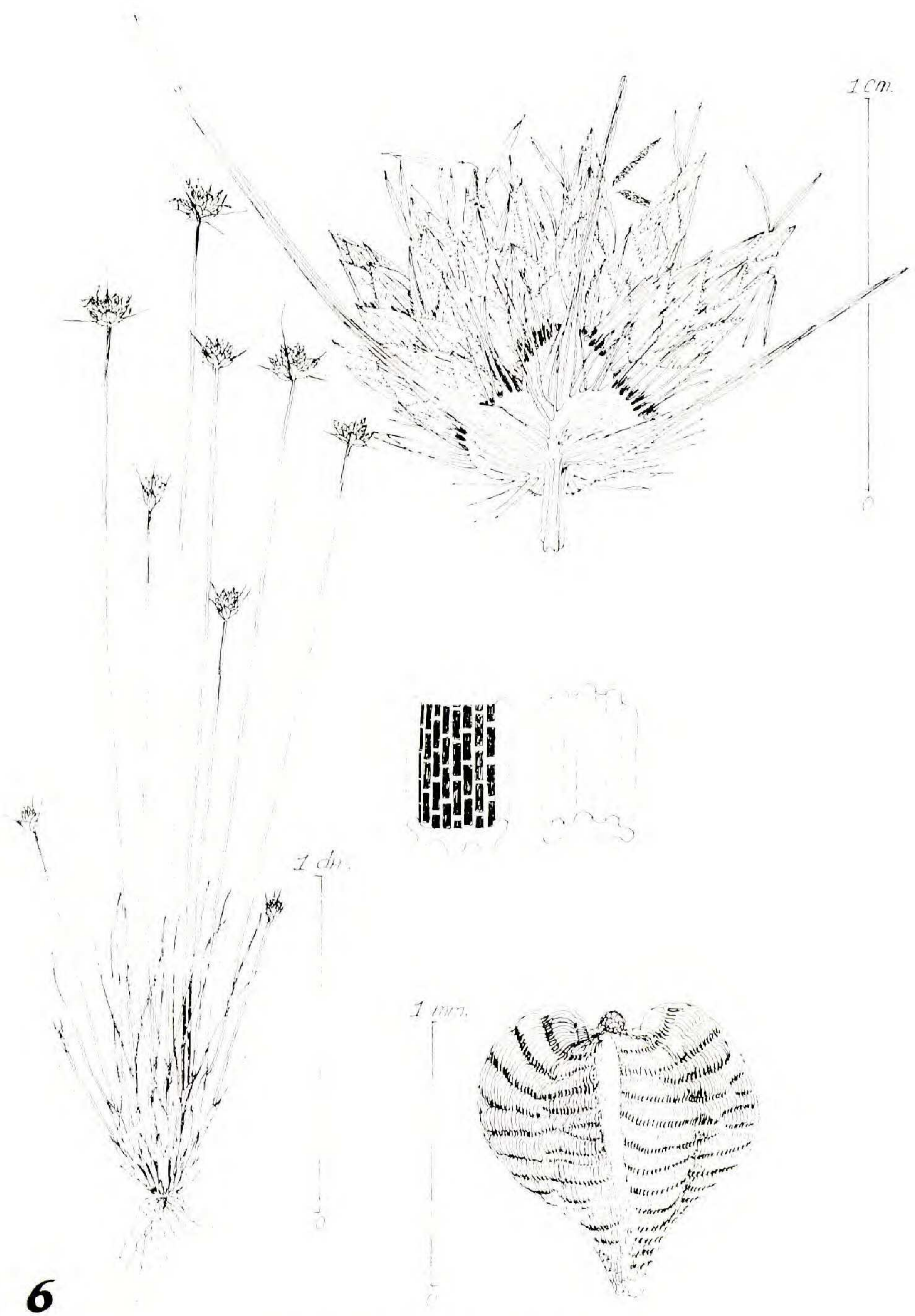
3. BULBOSTYLIS PARADOXA



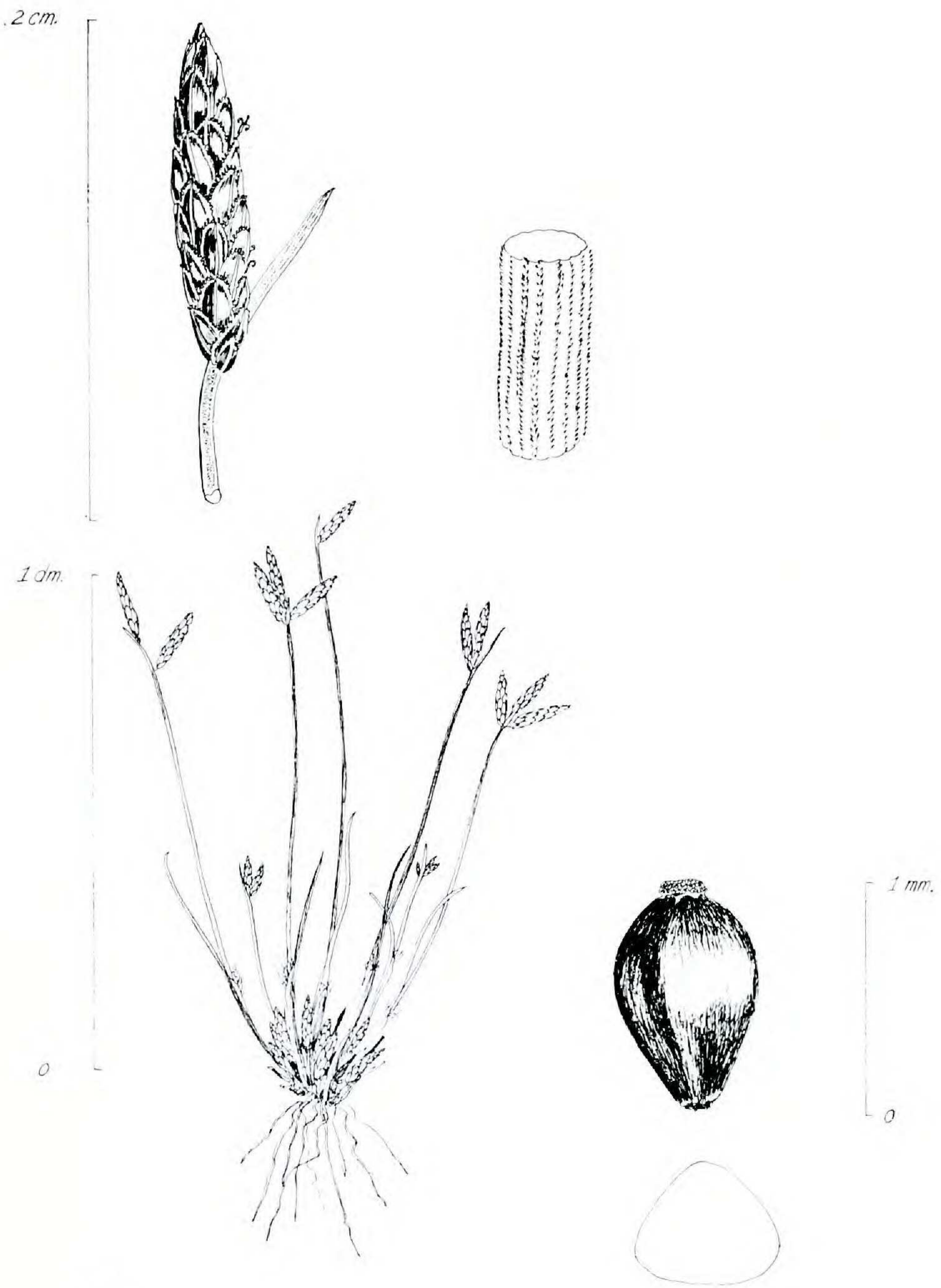
4. BULBOSTYLIS VESTITA



5. BULBOSTYLIS JUNCIFORMIS



6. BULBOSTYLIS WAREI

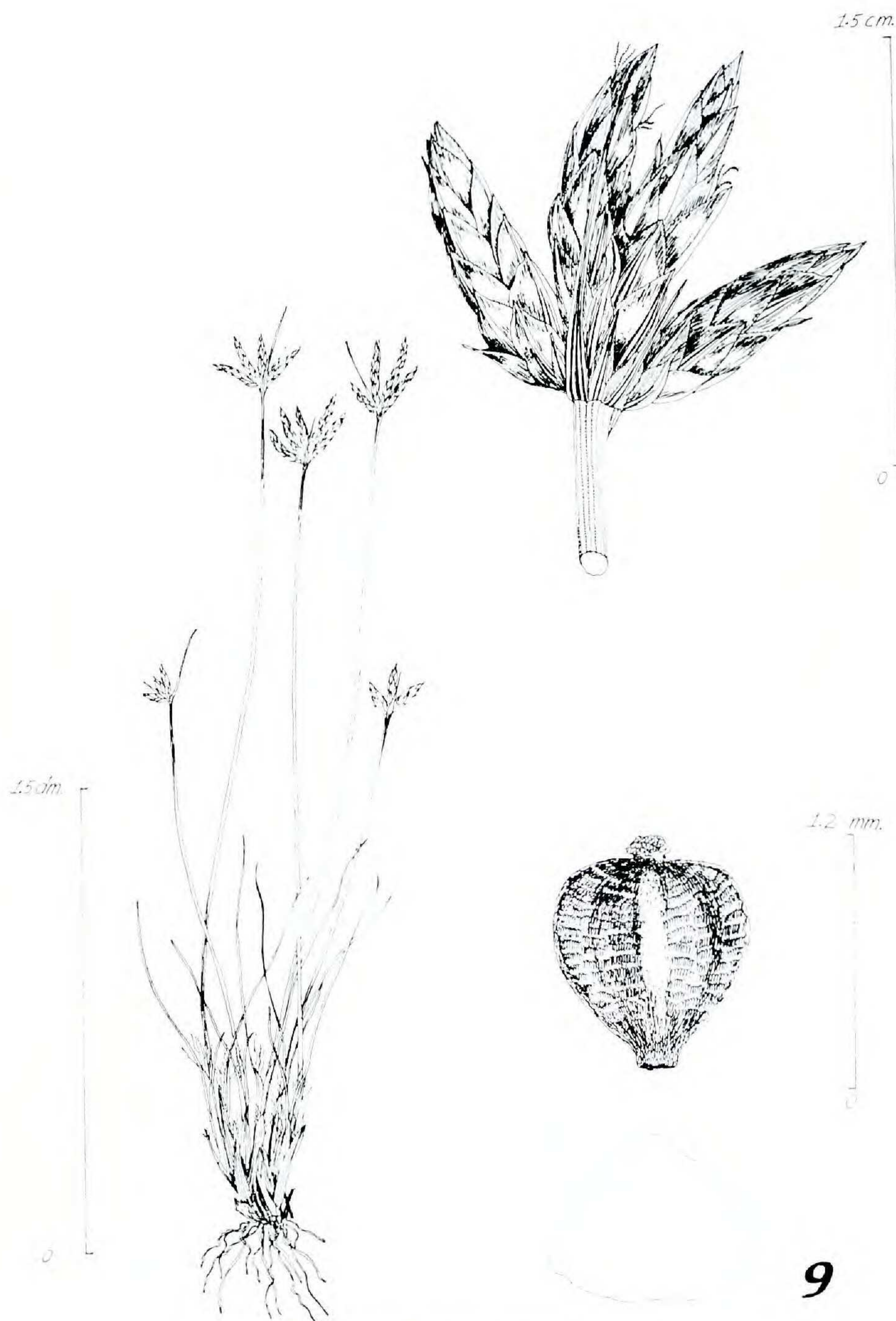


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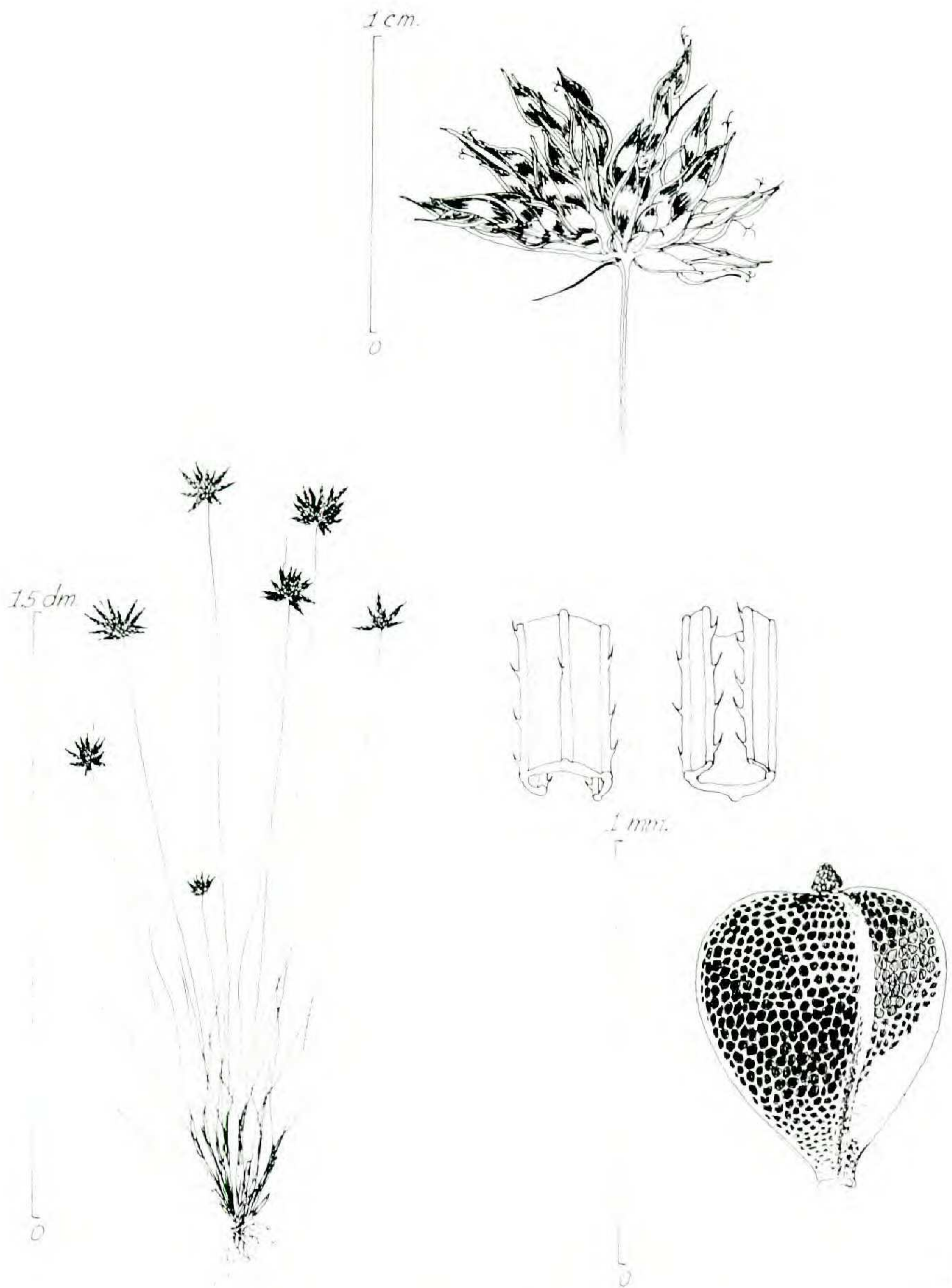
7. BULBOSTYLIS FLOCCOSA



8. BULBOSTYLIS SUBAPHYLLA

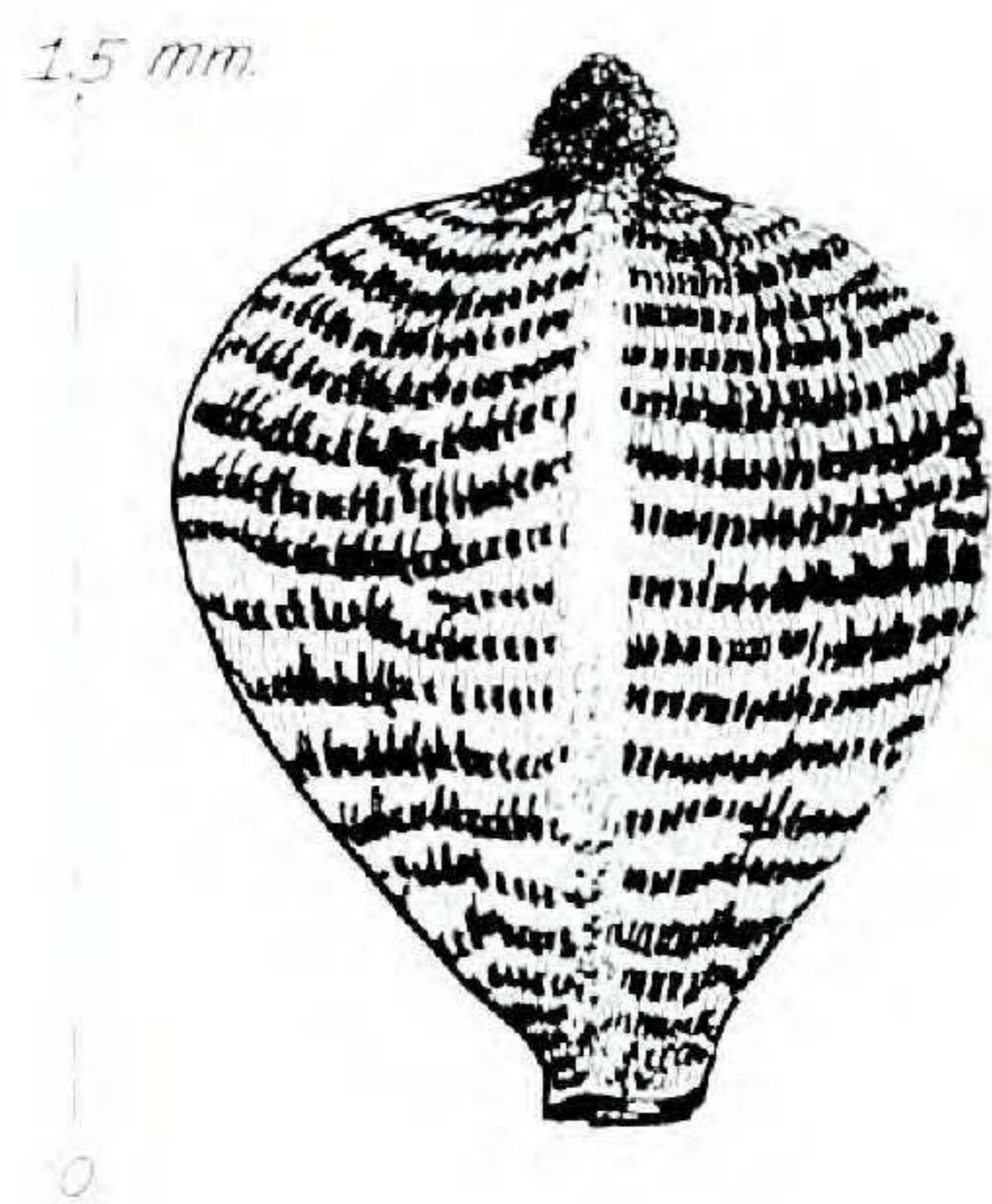
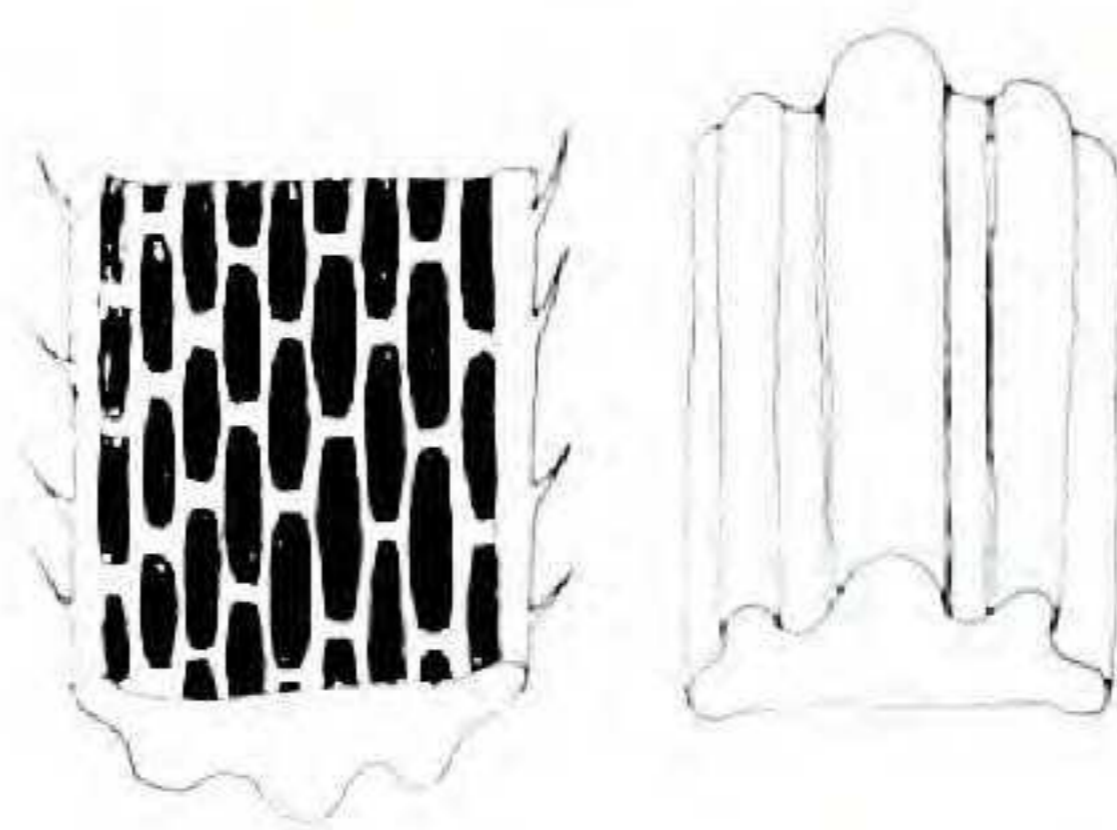
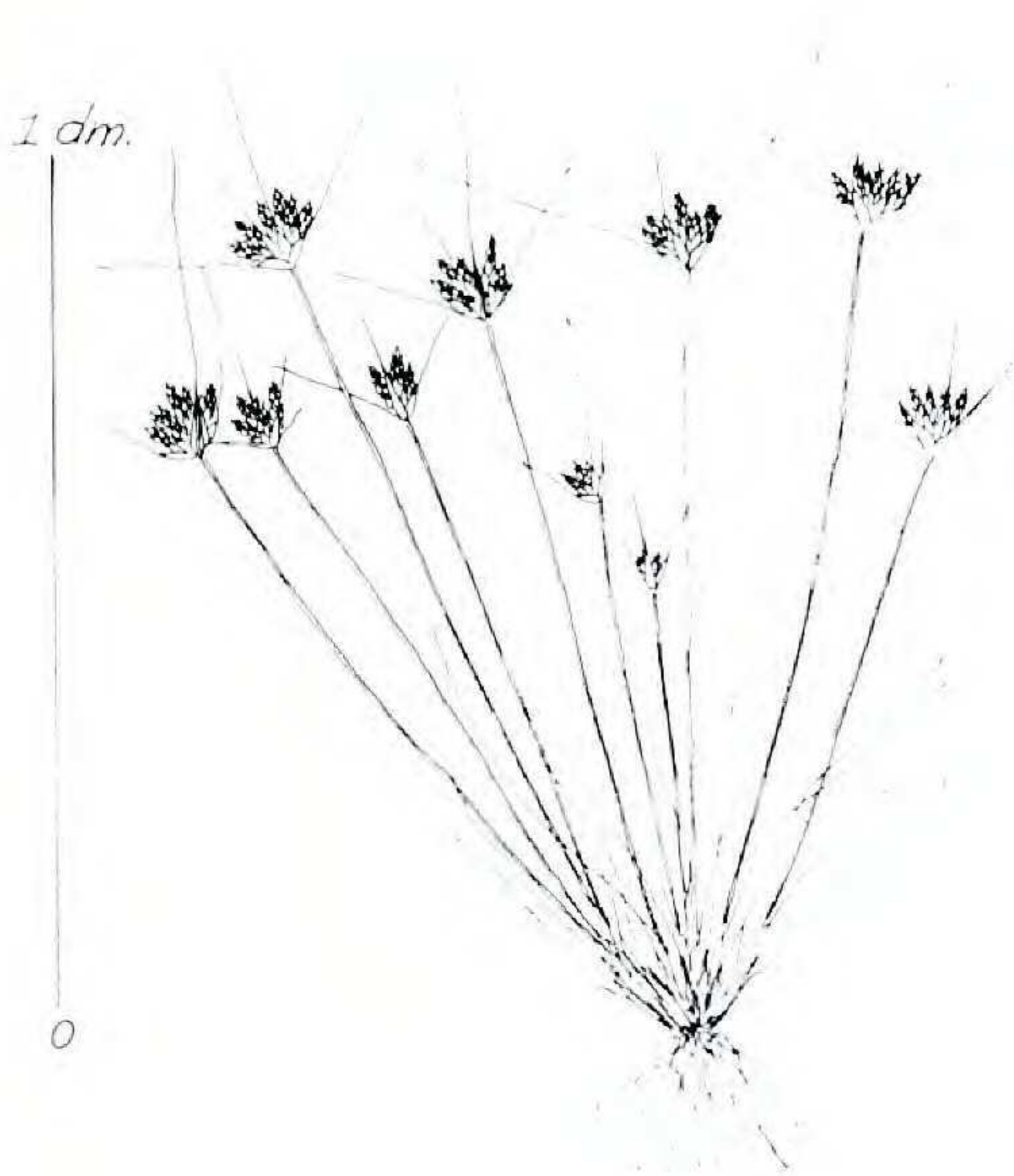
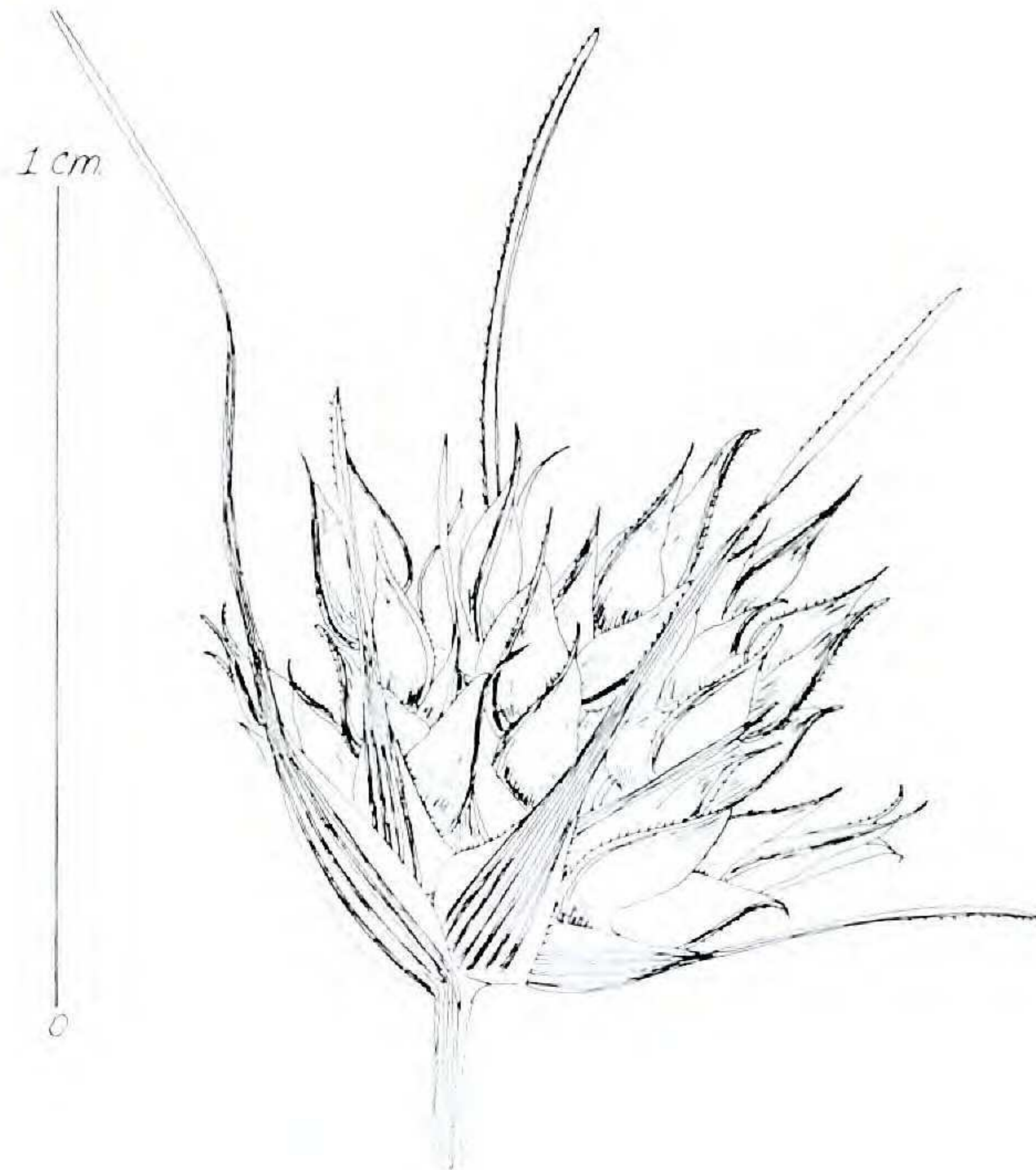


9. BULBOSTYLIS NESIOTICA



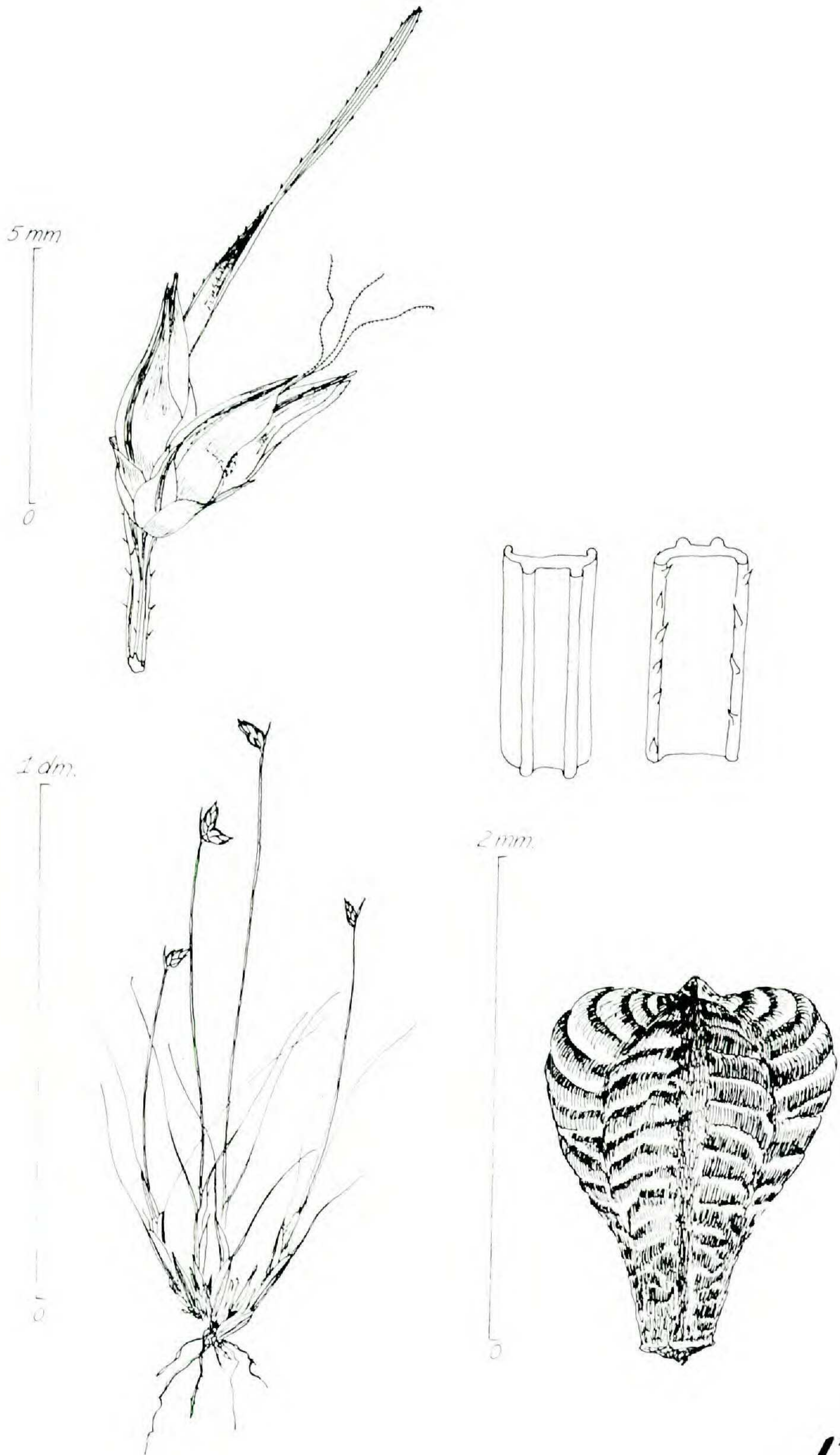
10. BULBOSTYLIS BARBATA

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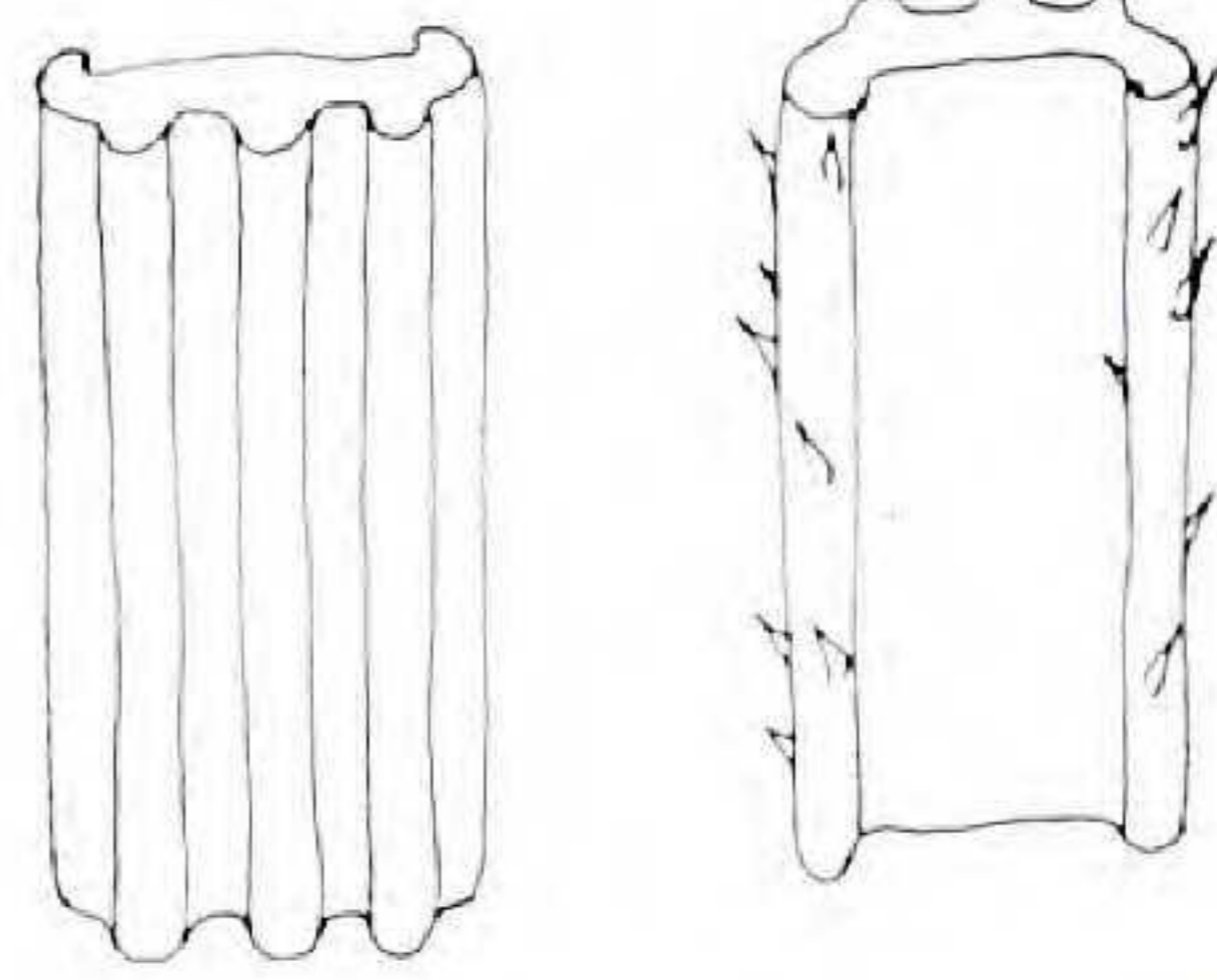
11. BULBOSTYLIS STENOPHYLLA



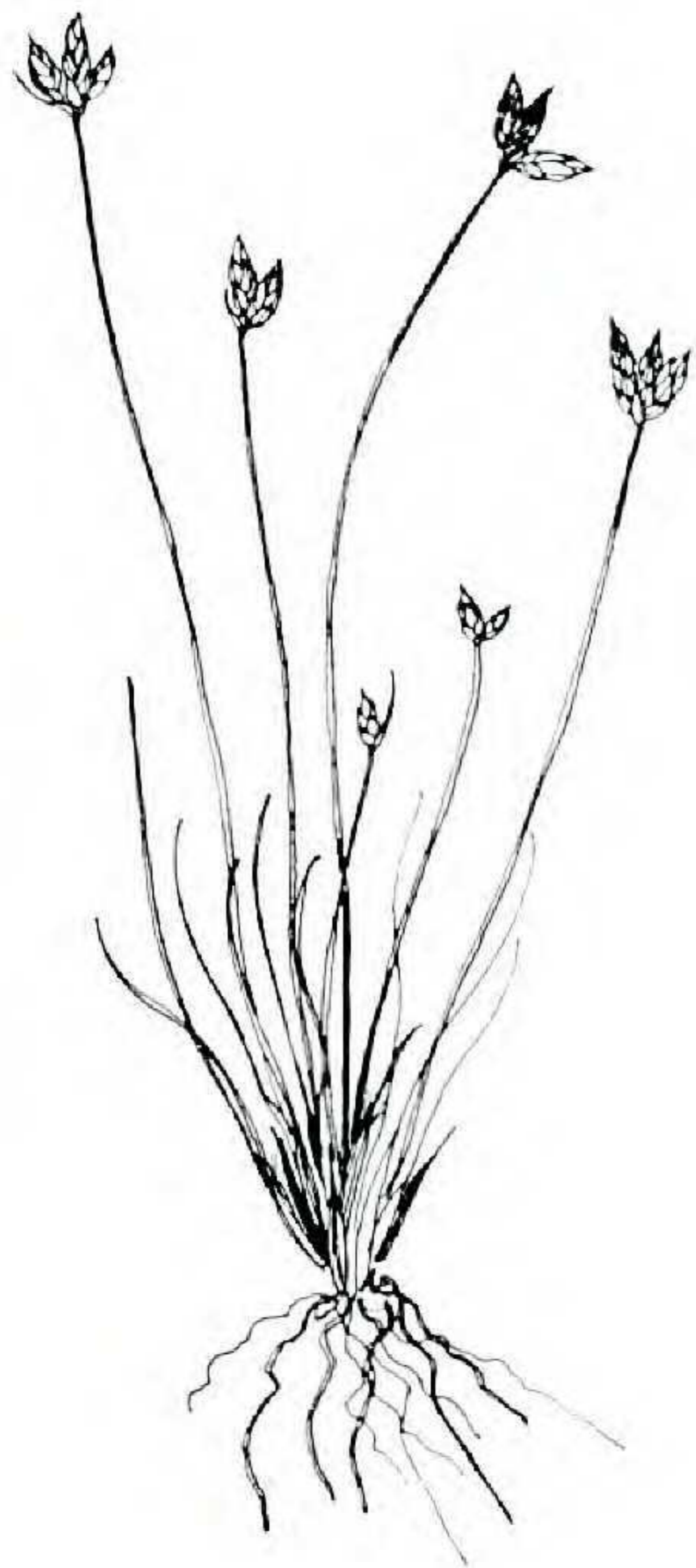
12. BULBOSTYLIS SETACEA

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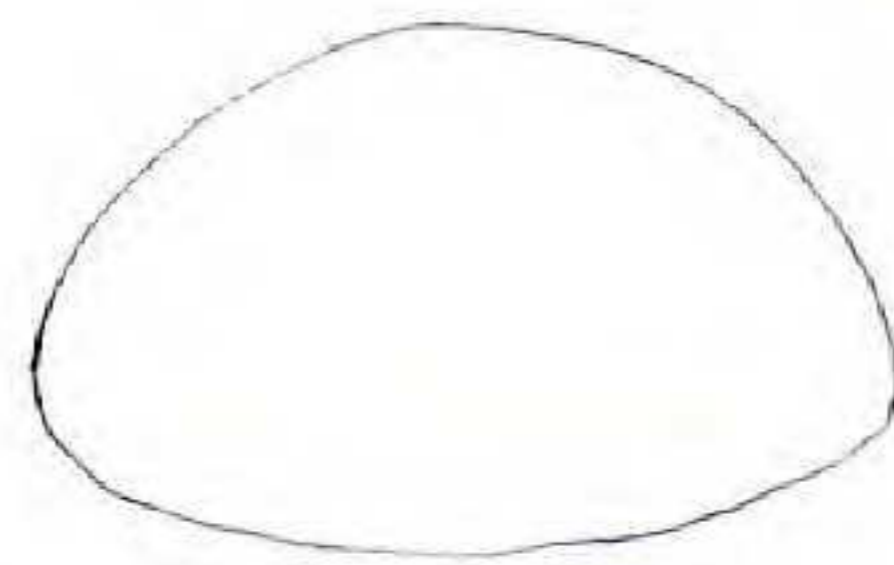
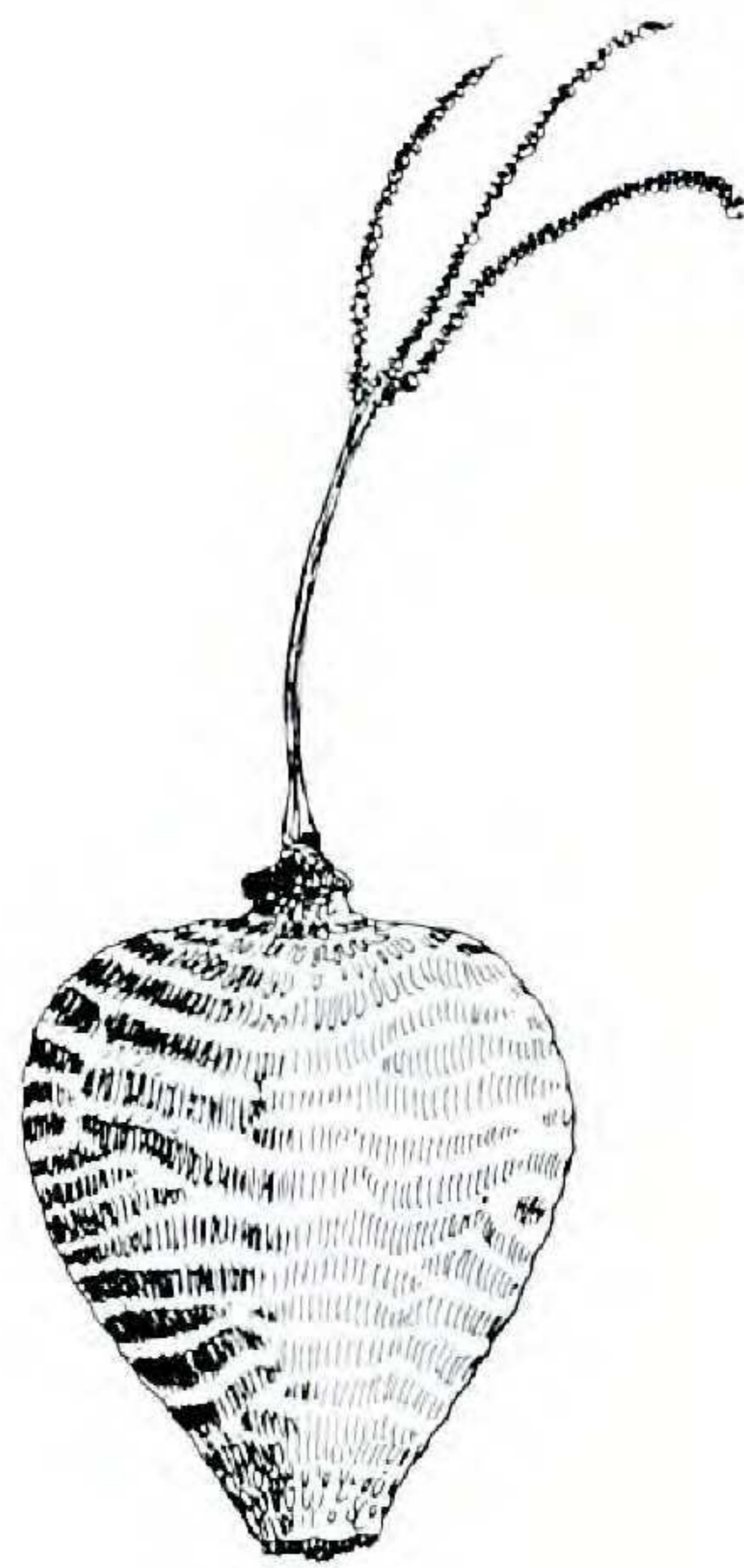
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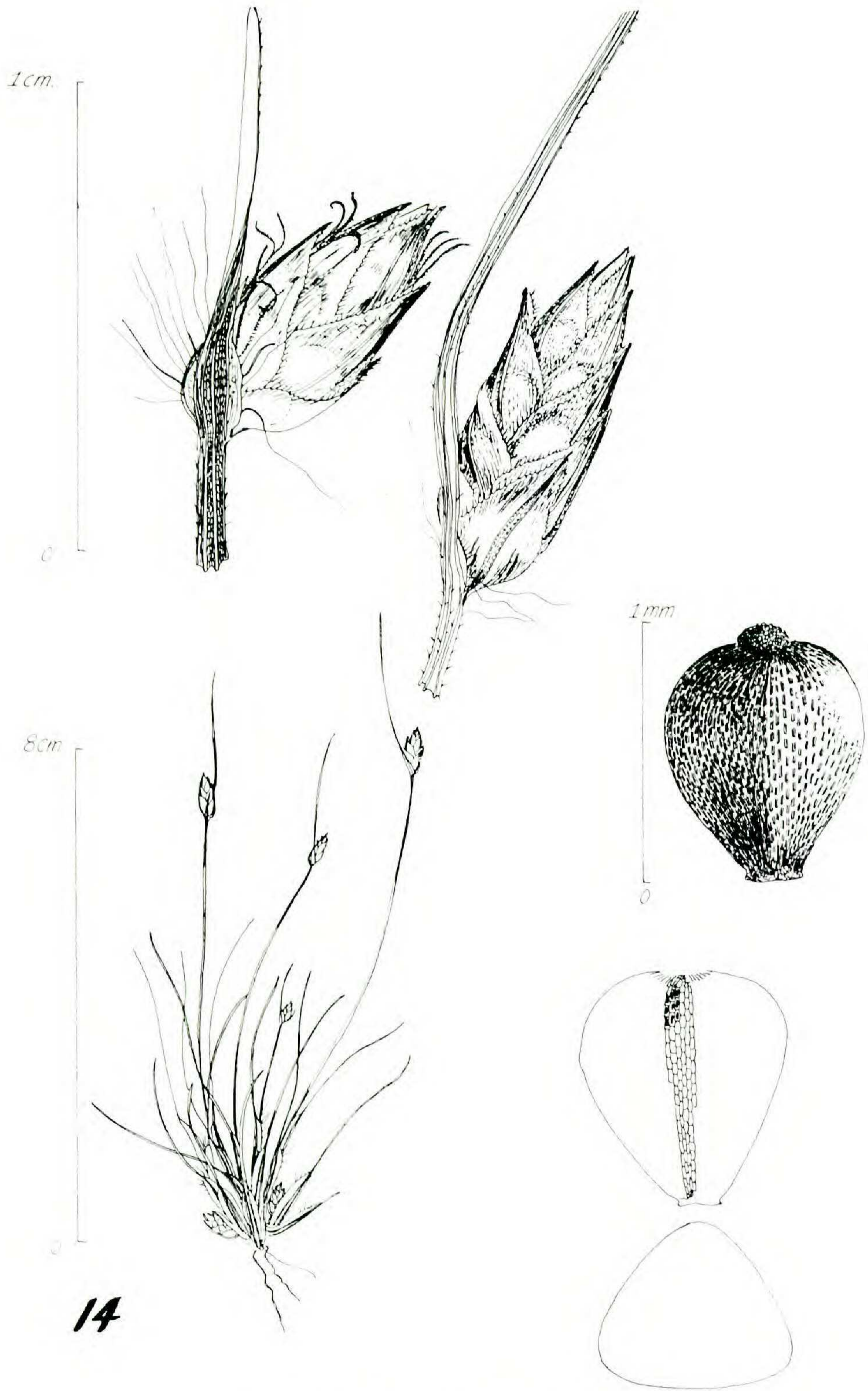
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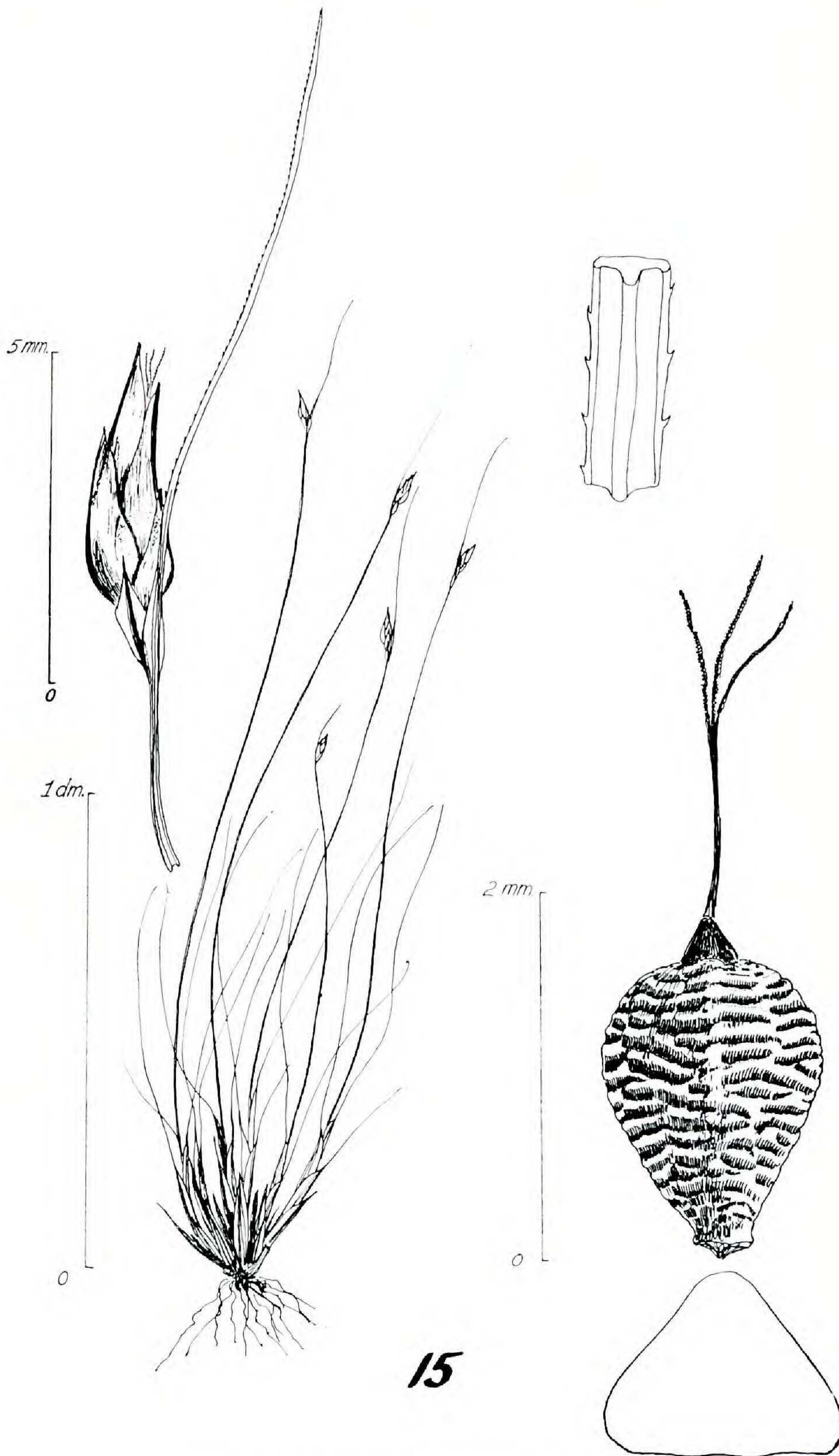
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13. BULBOSTYLIS SEPIACEA

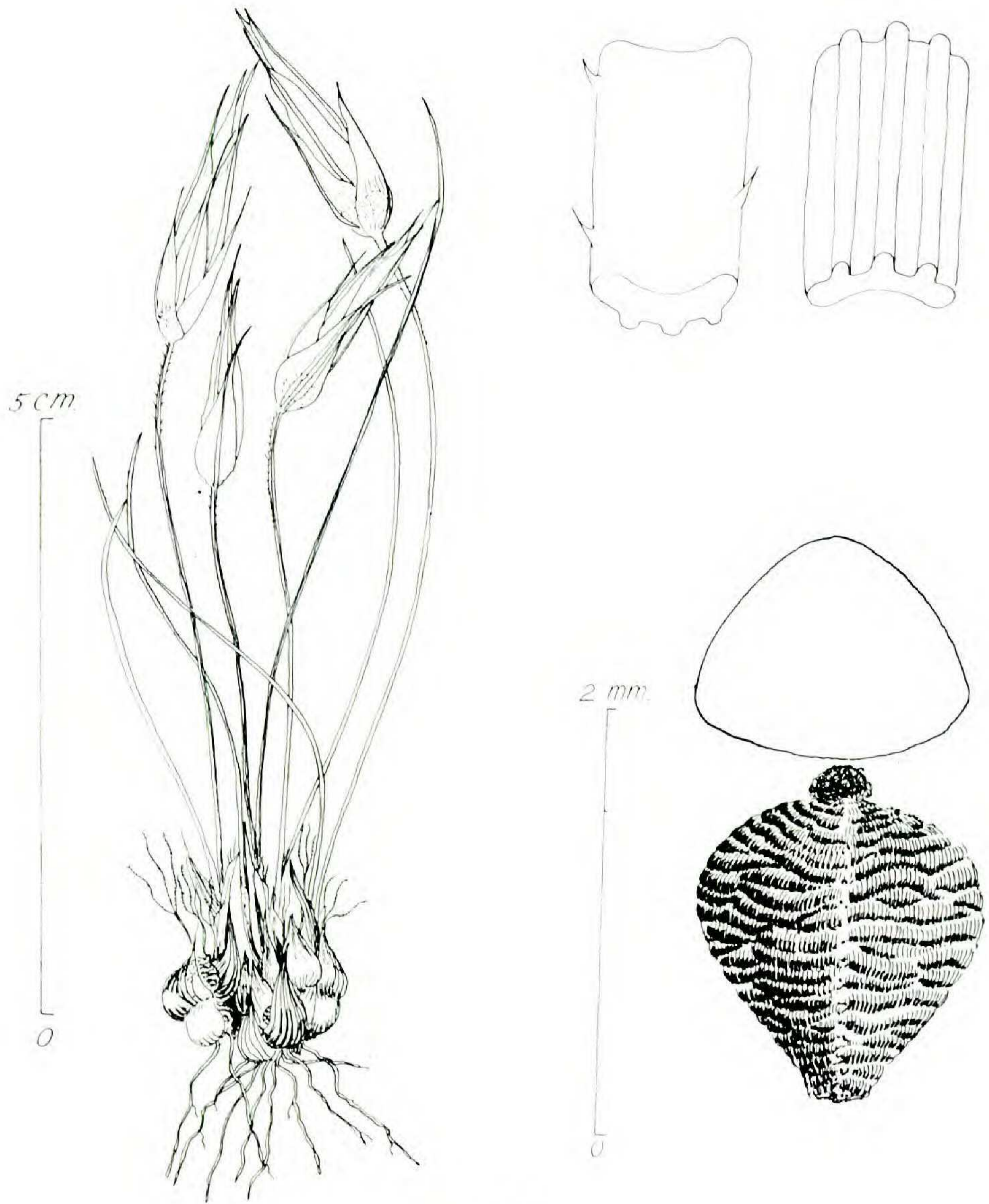


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14. BULBOSTYLIS CURASSAVICA

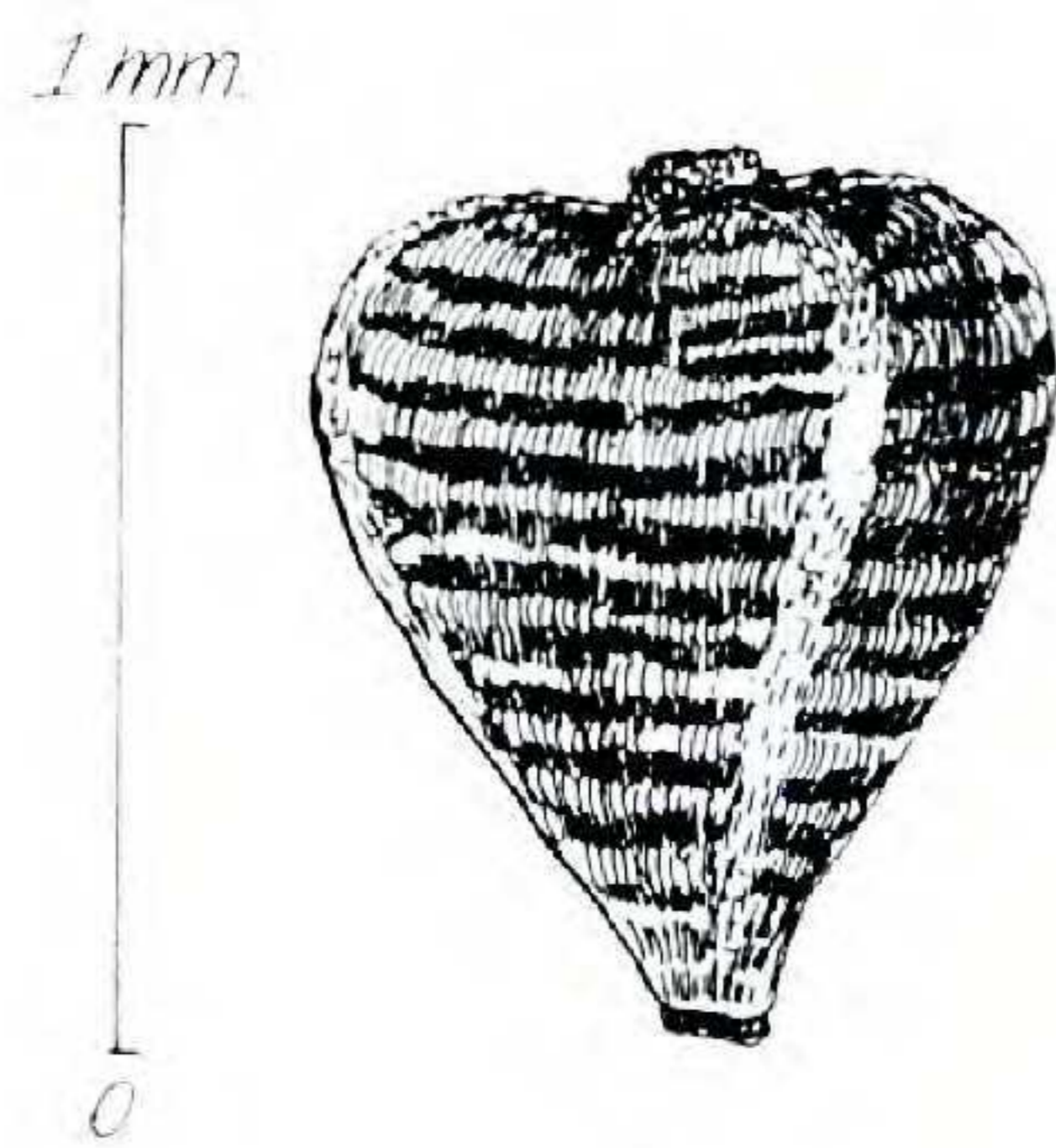
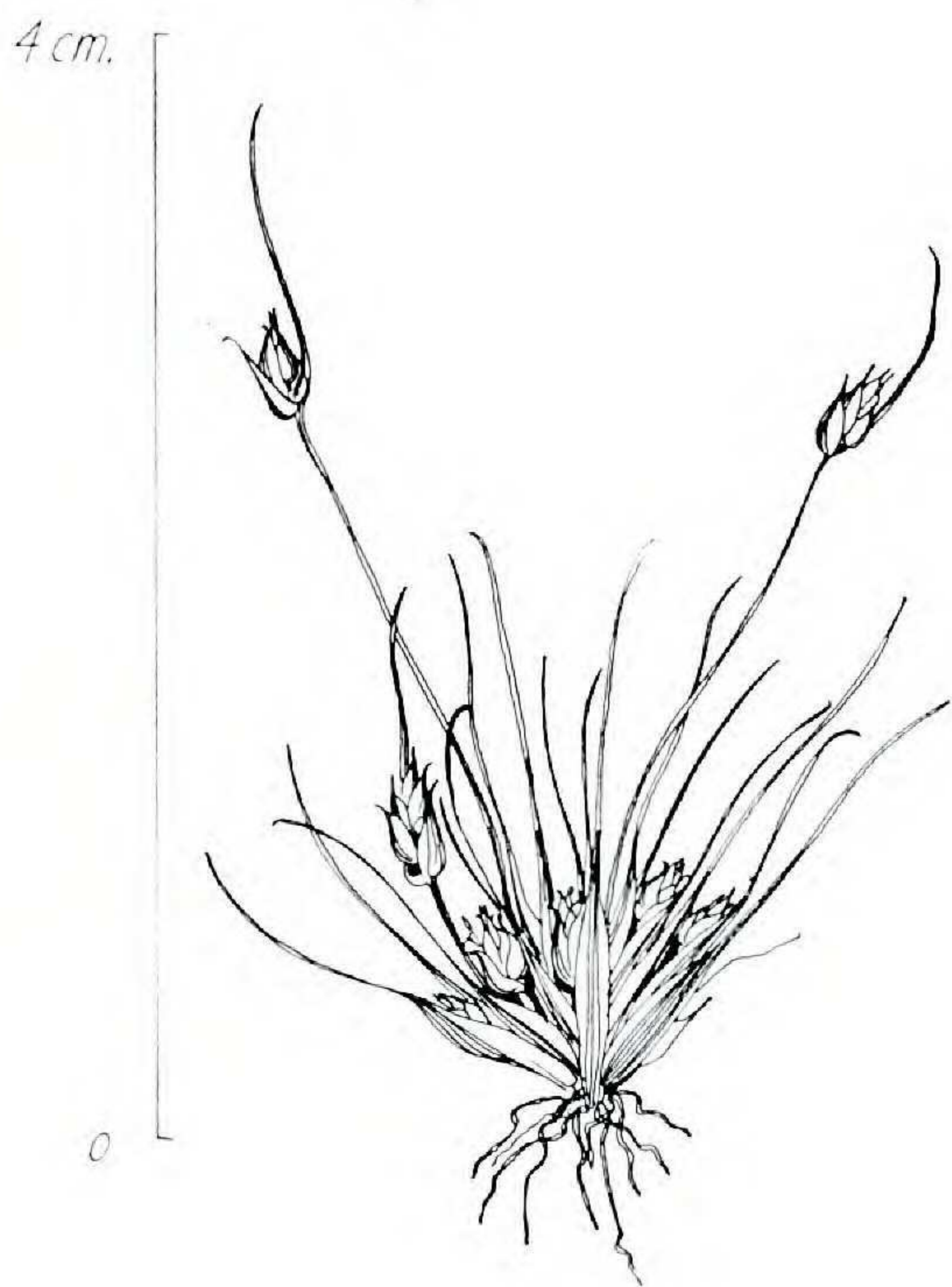
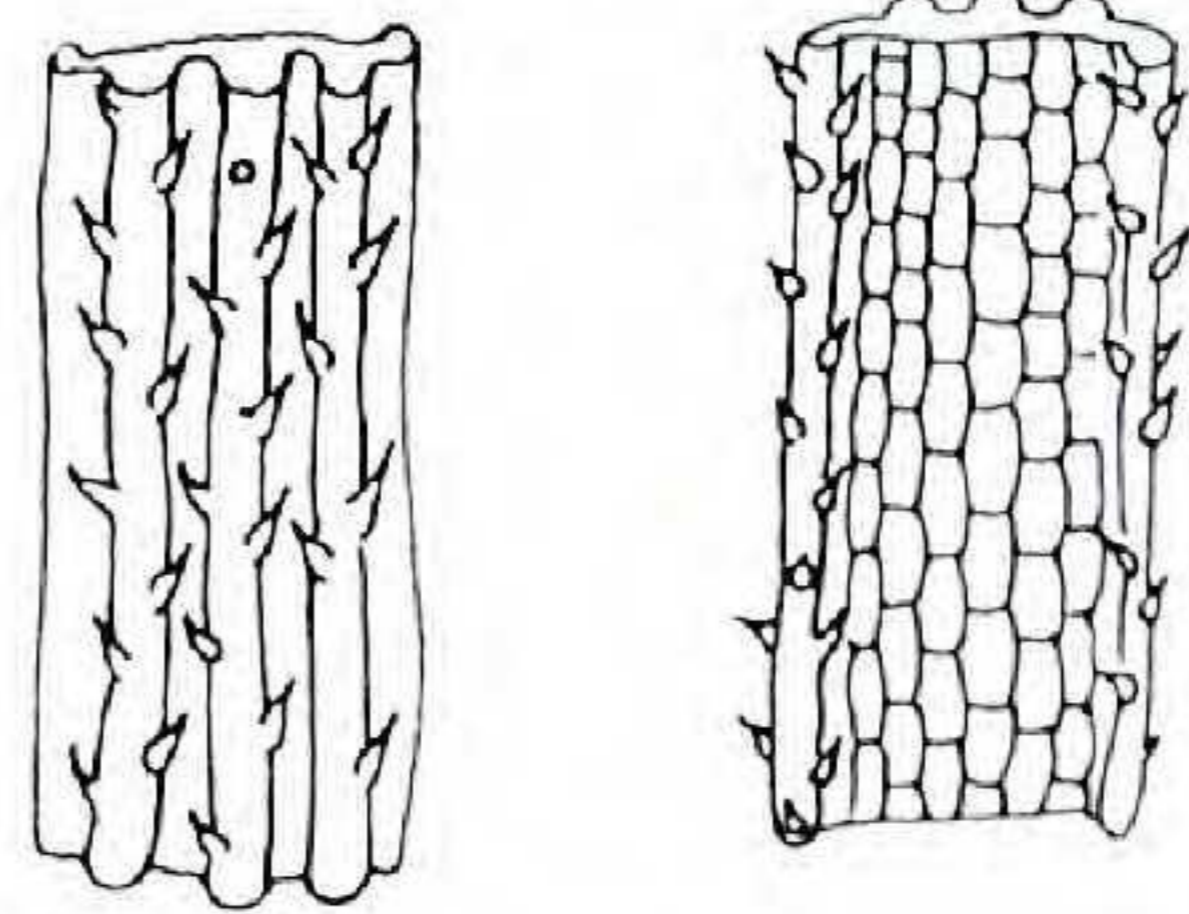
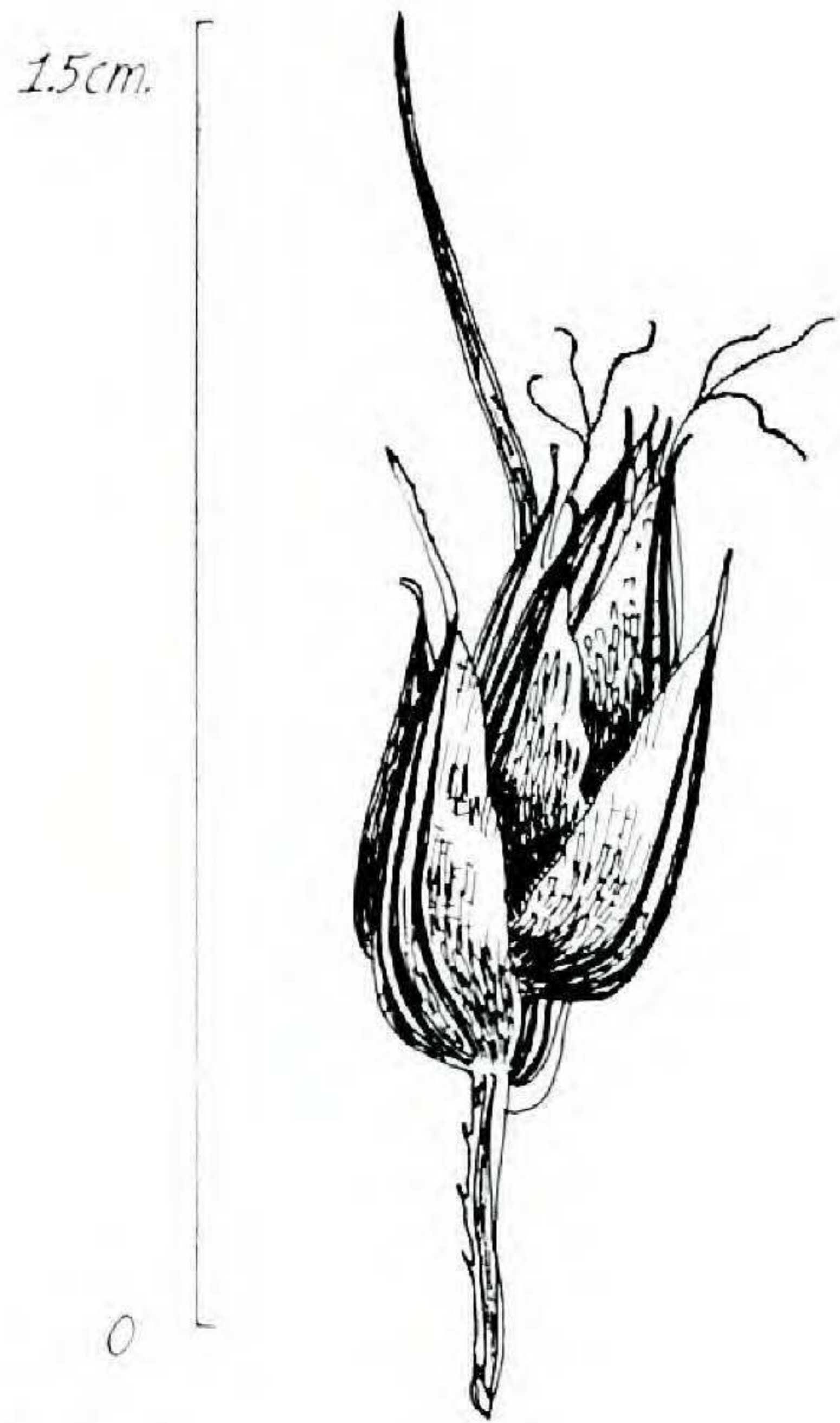


15. BULBOSTYLIS PAUCIFLORA



16

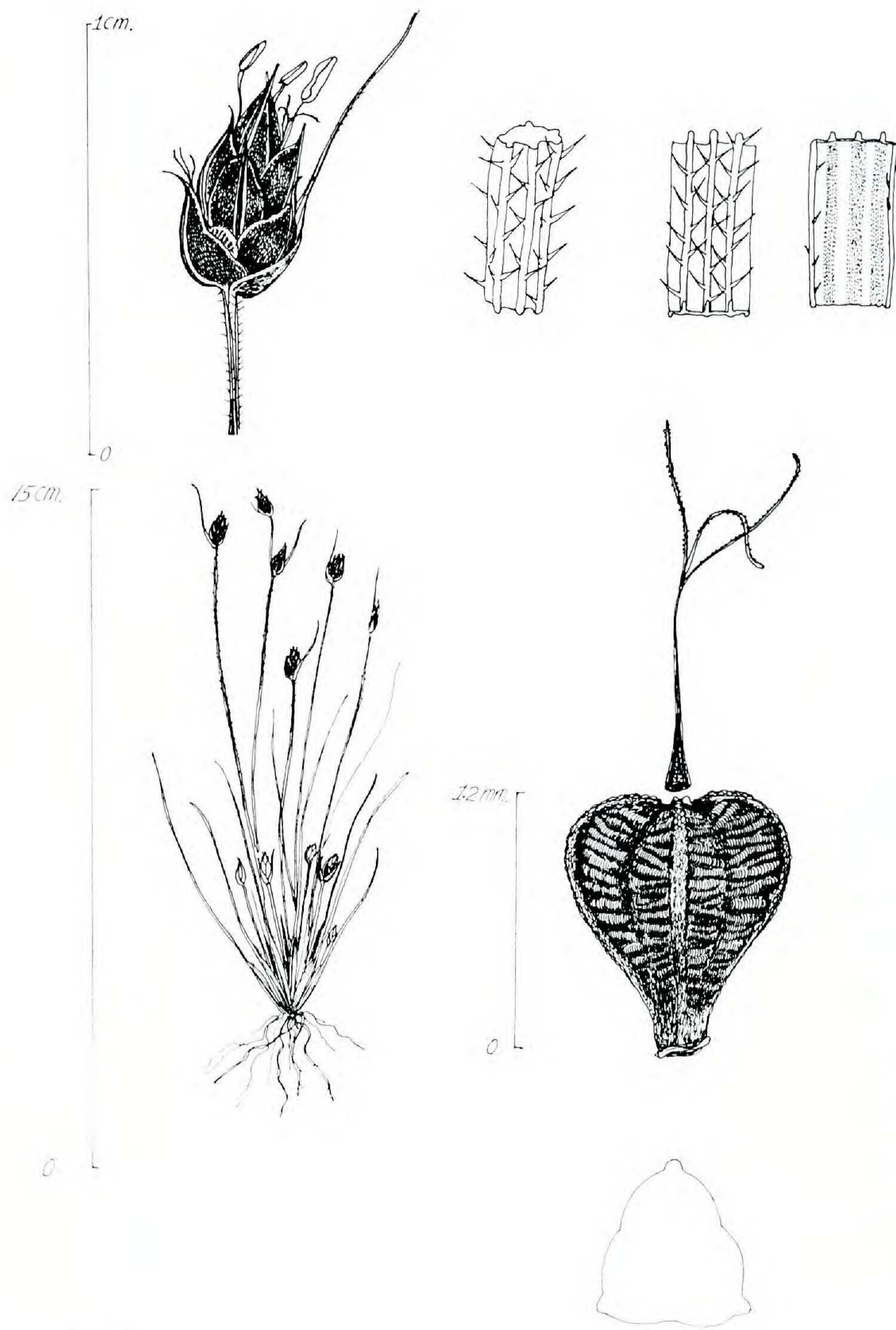
16. BULBOSTYLIS FUNCKII



17
17. BULBOSTYLIS SCHAFFNERI

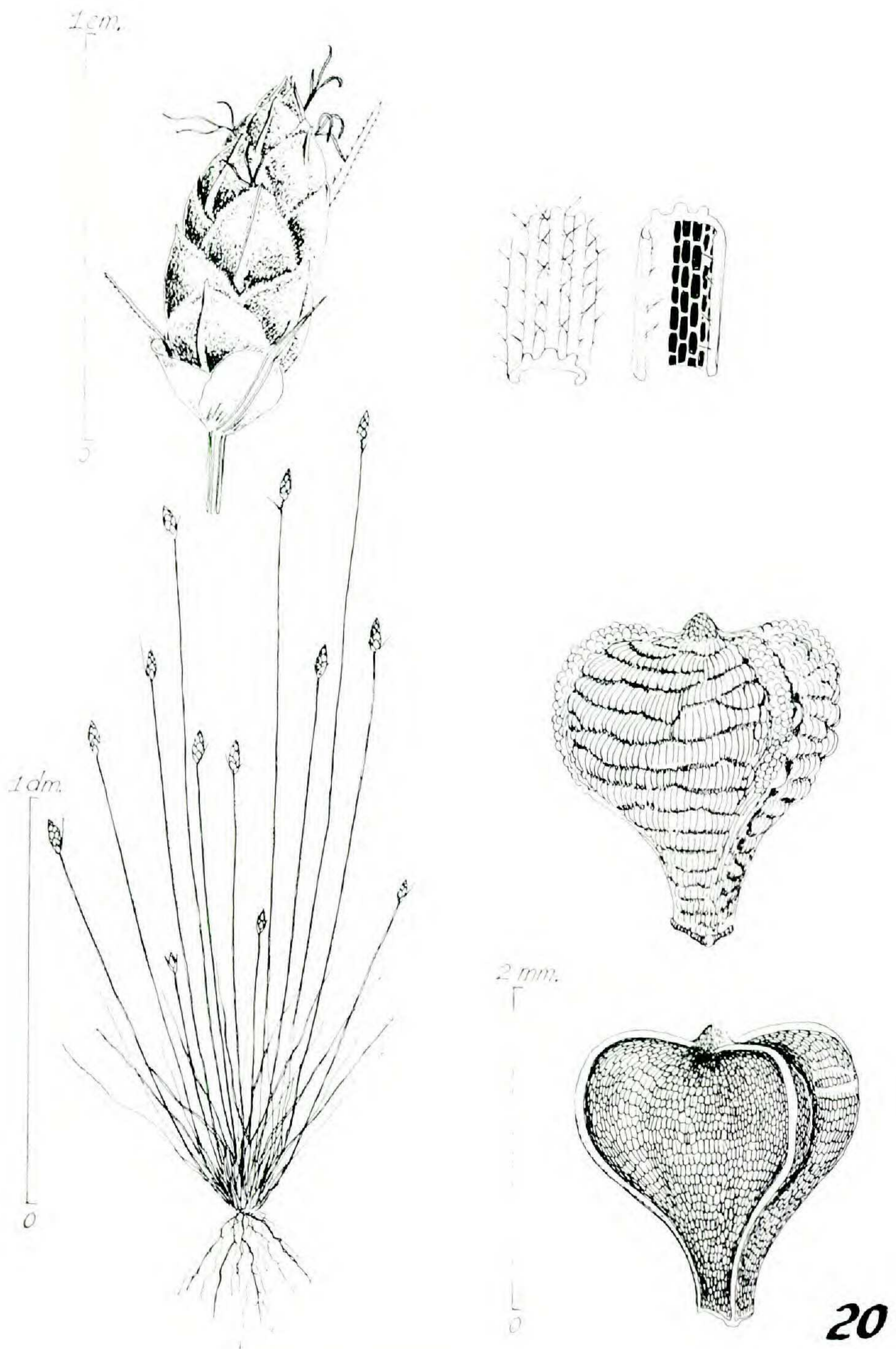


18. BULBOSTYLIS TRILOBATA

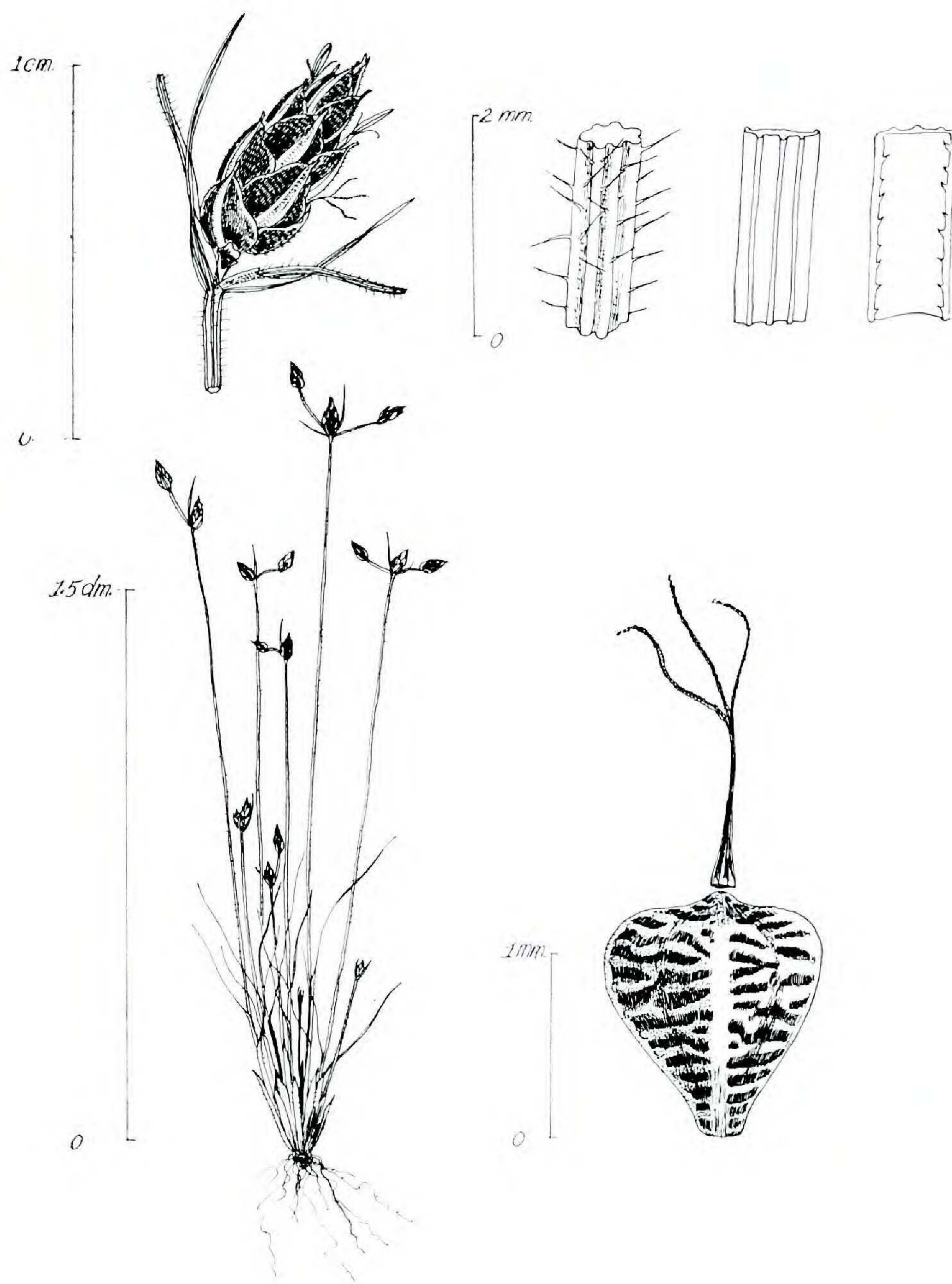


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19. BULBOSTYLIS ARCUATA

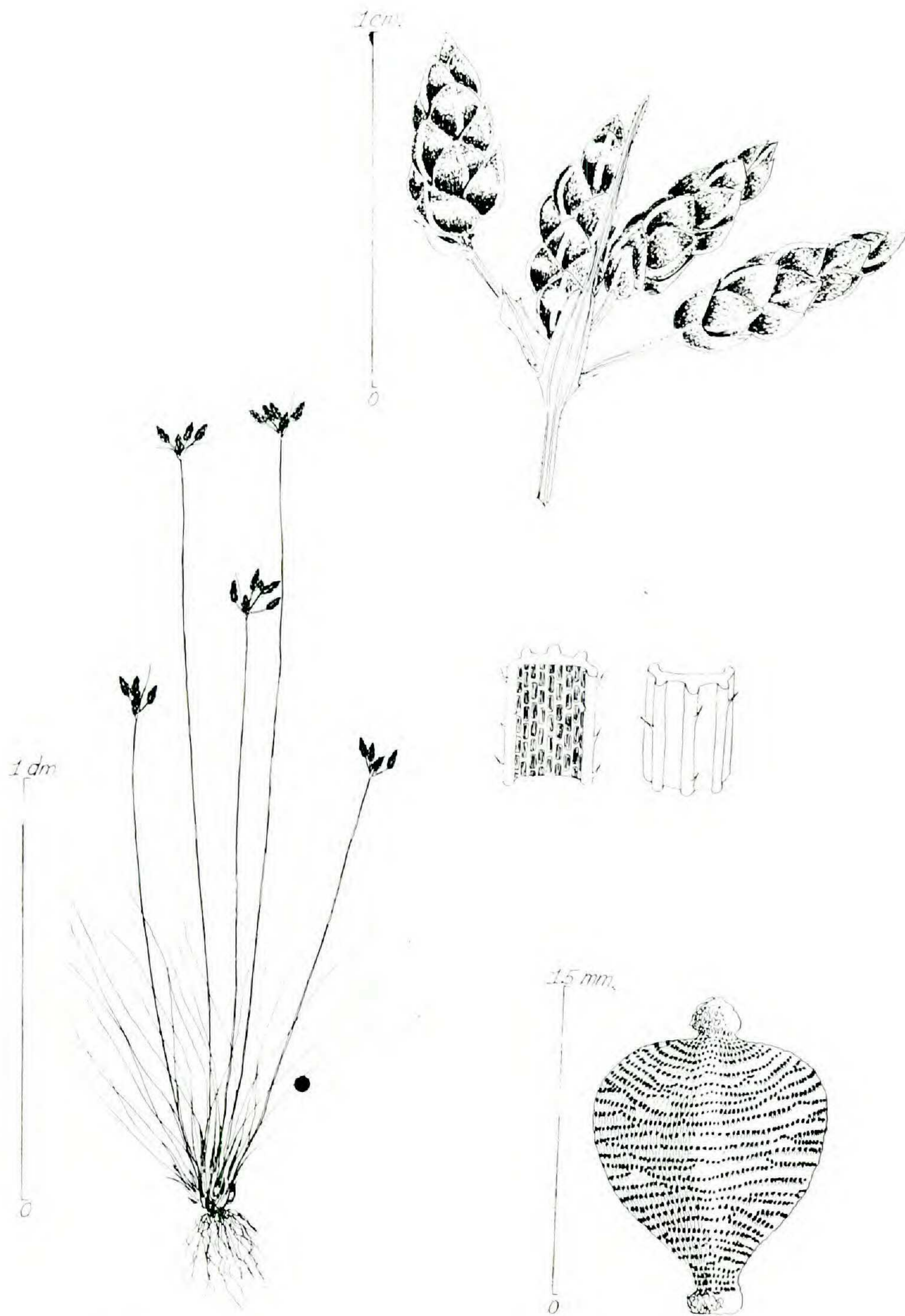


20. BULBOSTYLIS PUBESCENS



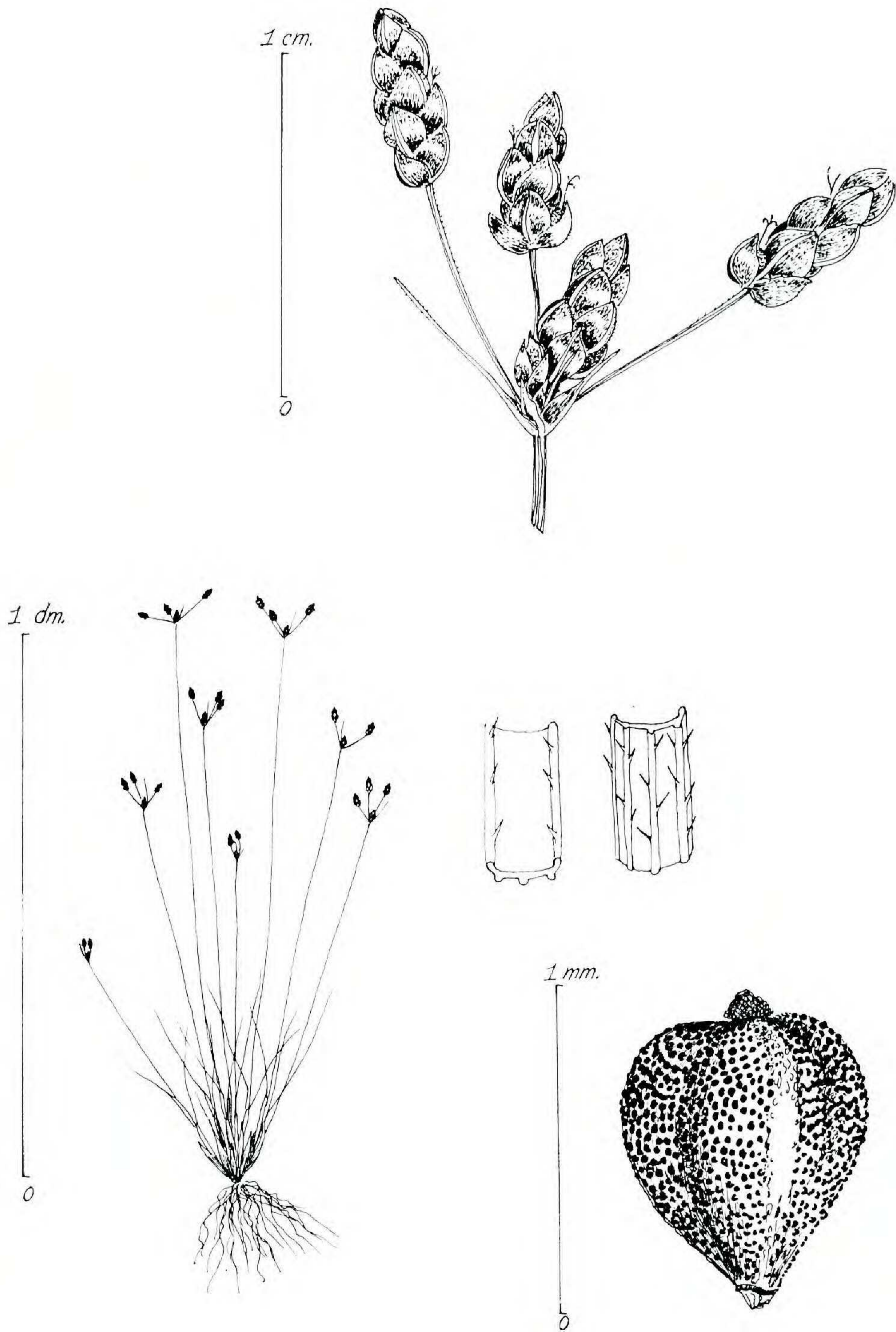
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21. BULBOSTYLIS HIRTA



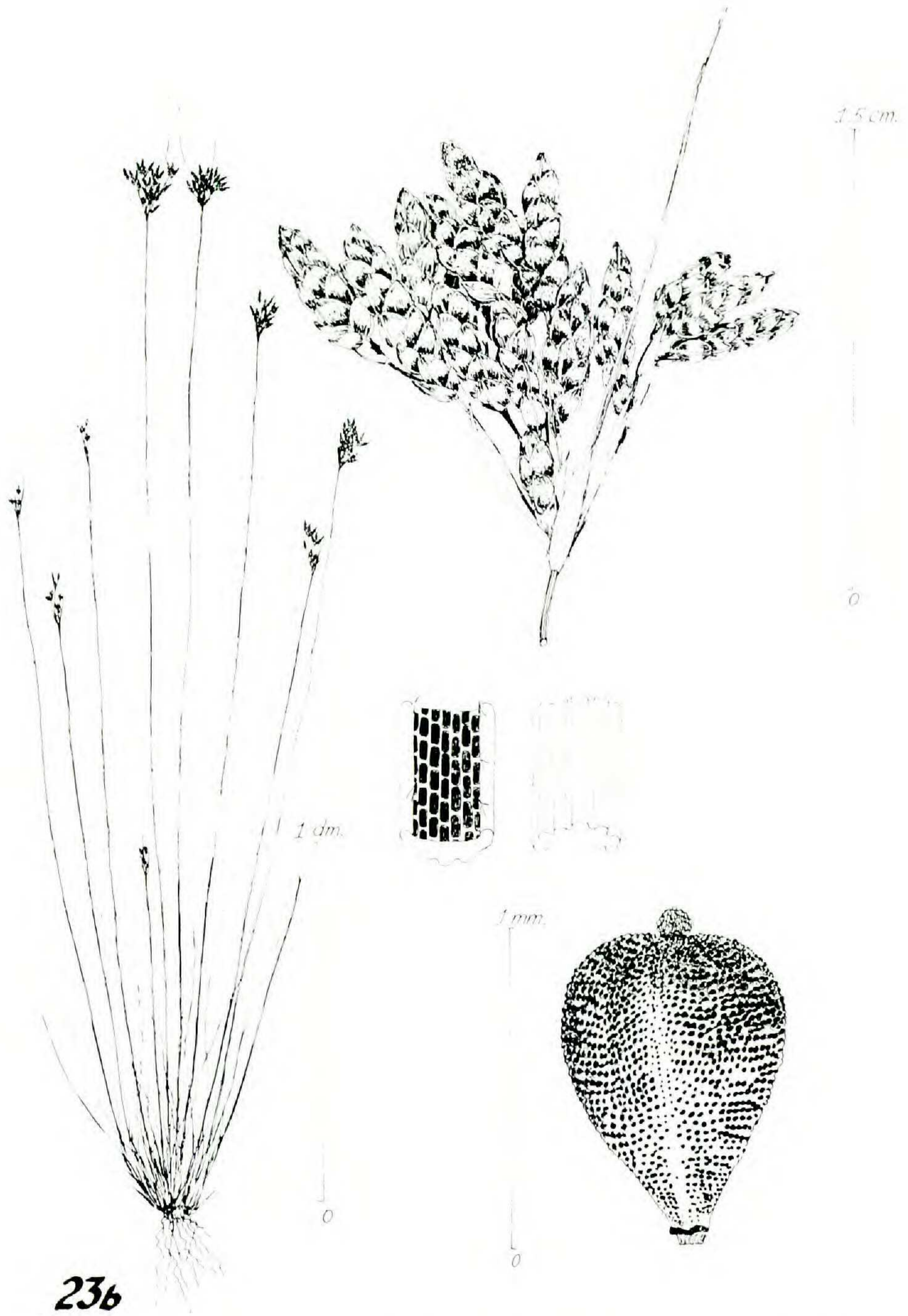
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22. BULBOSTYLIS JUNCOIDES



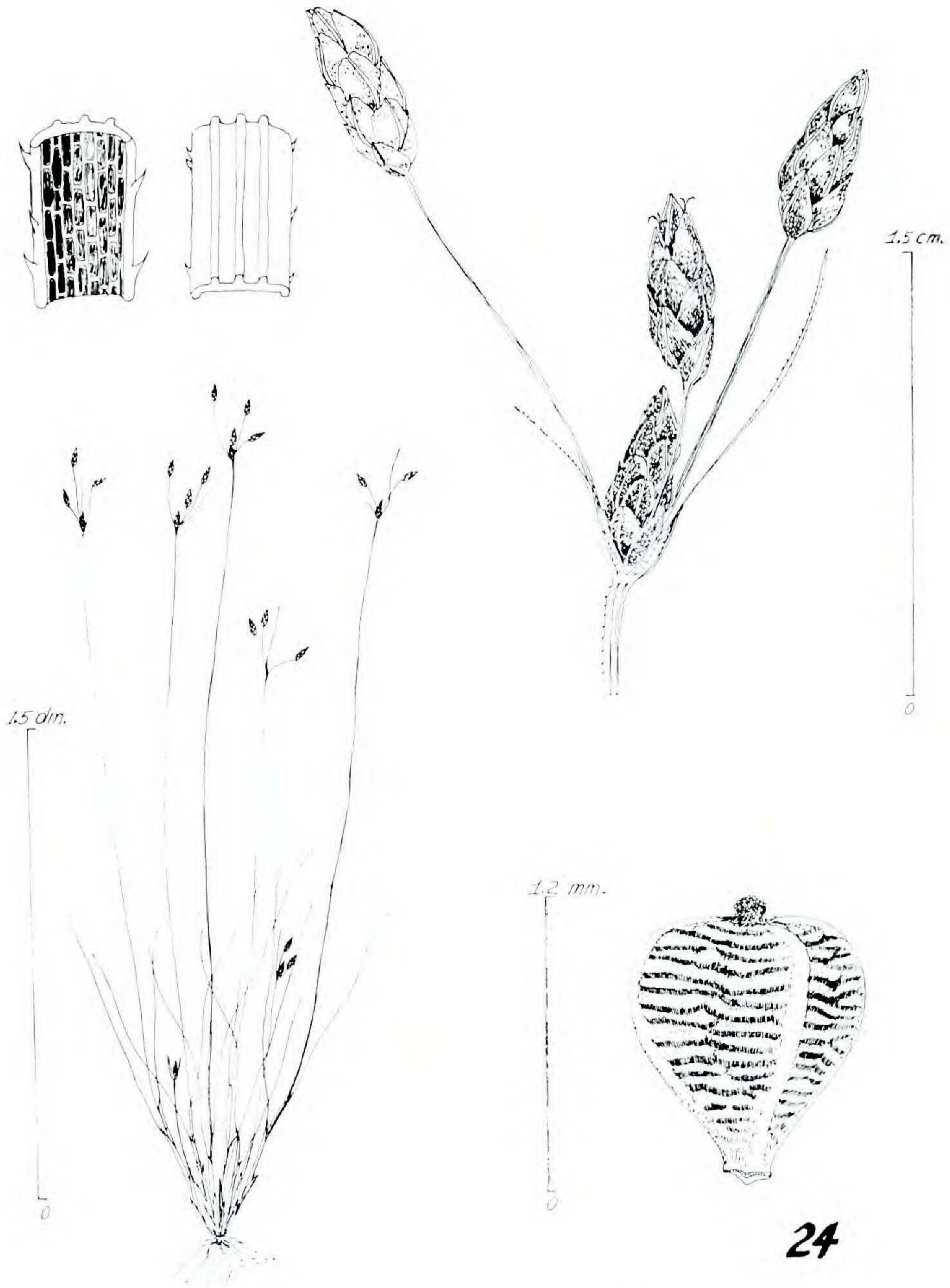
23a

23a. BULBOSTYLIS CILIATIFOLIA VAR. CILIATIFOLIA

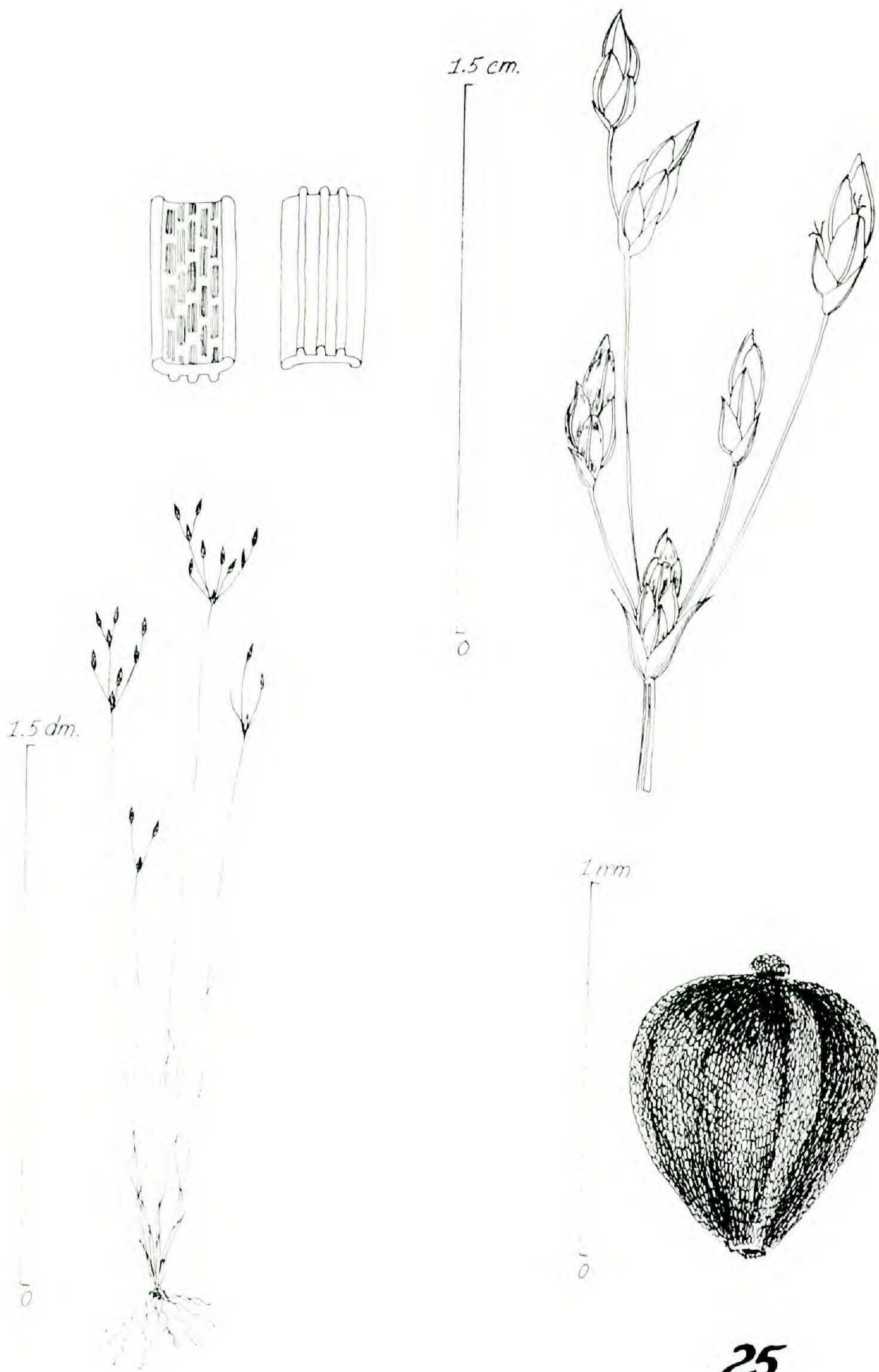


23b

23b. *BULBOSTYLIS CILIATIFOLIA* VAR. *COARCTATA*

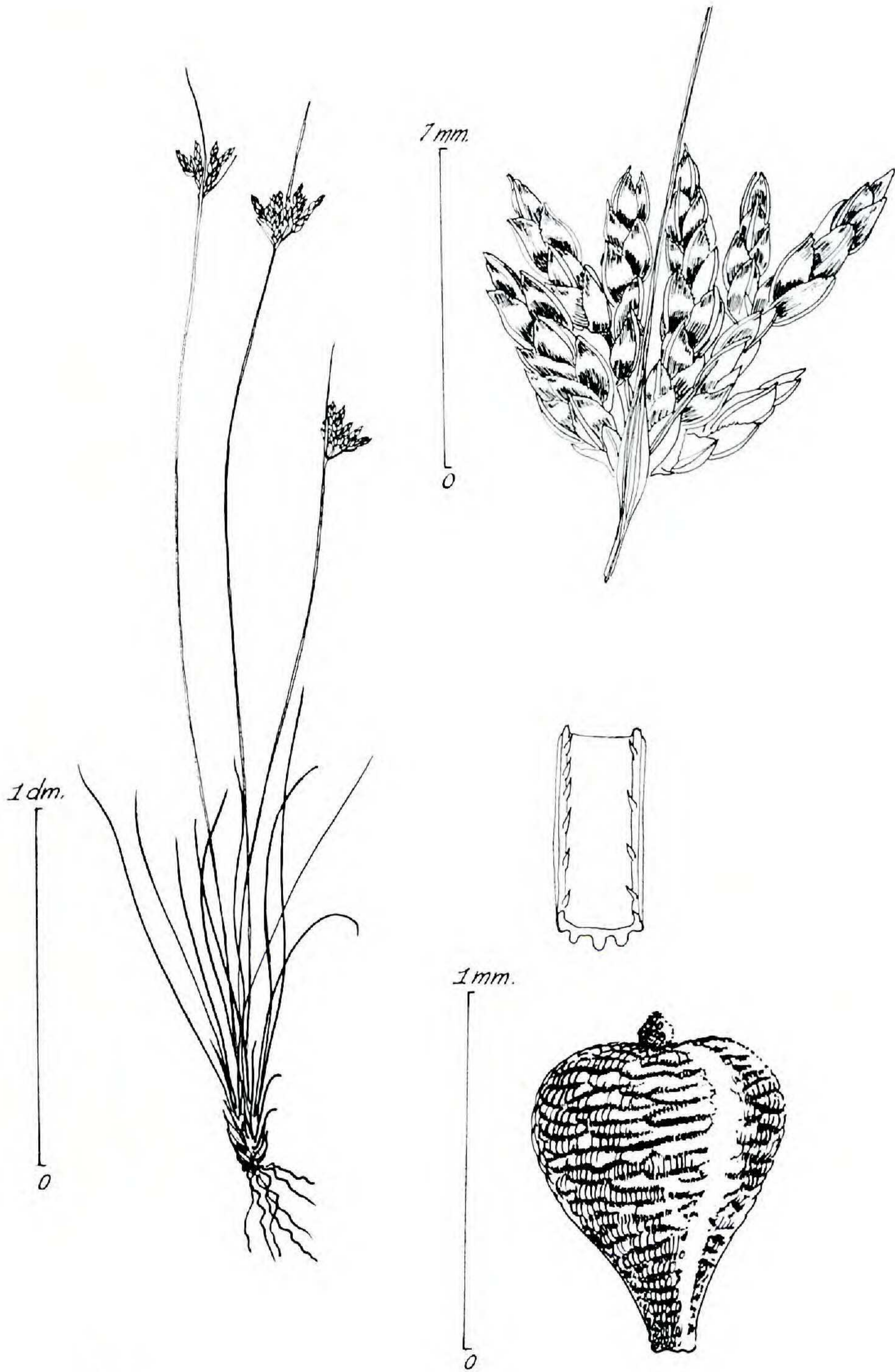


24. BULBOSTYLIS CAPILLARIS



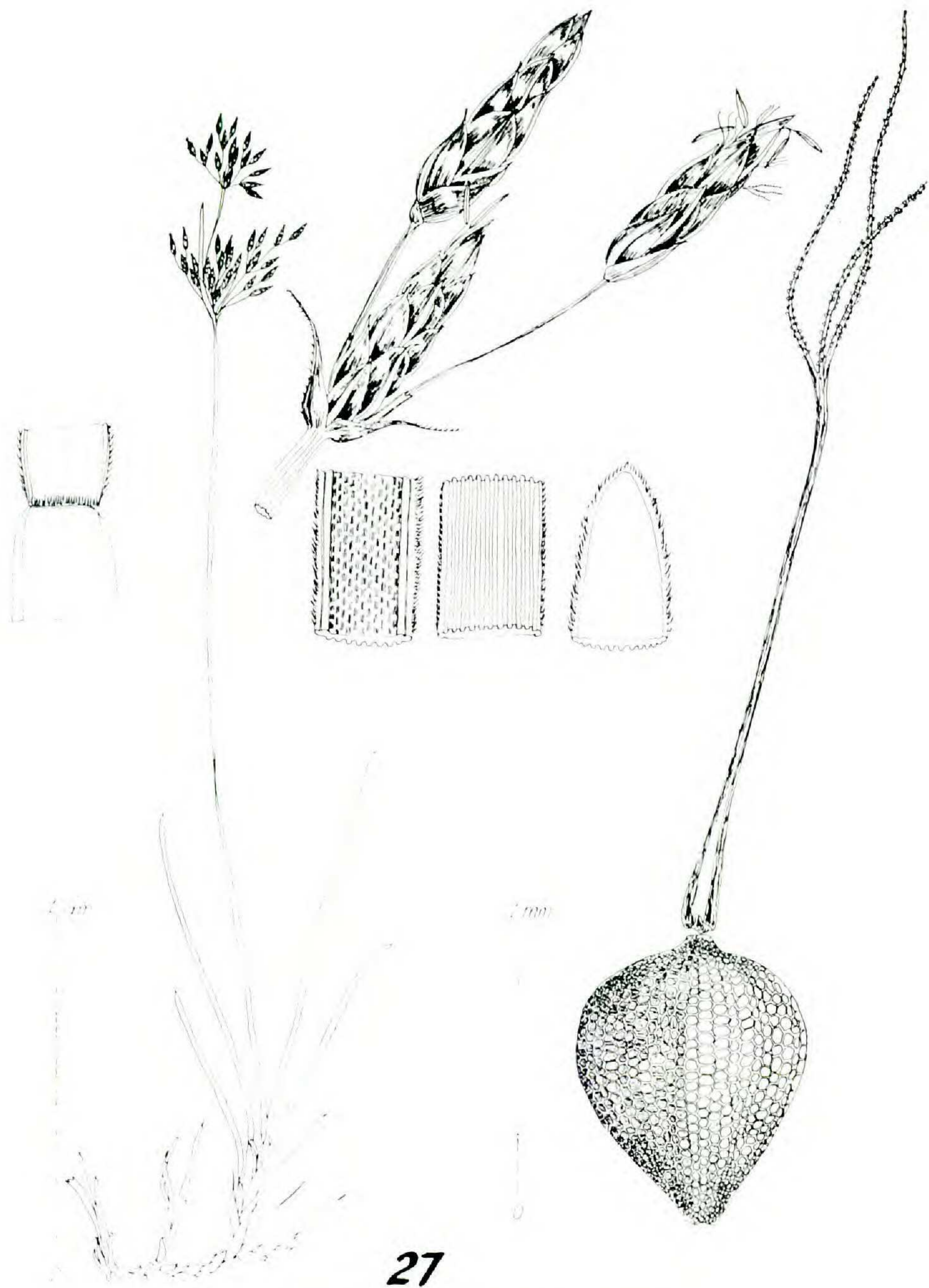
25. BULBOSTYLIS TENUIFOLIA

25

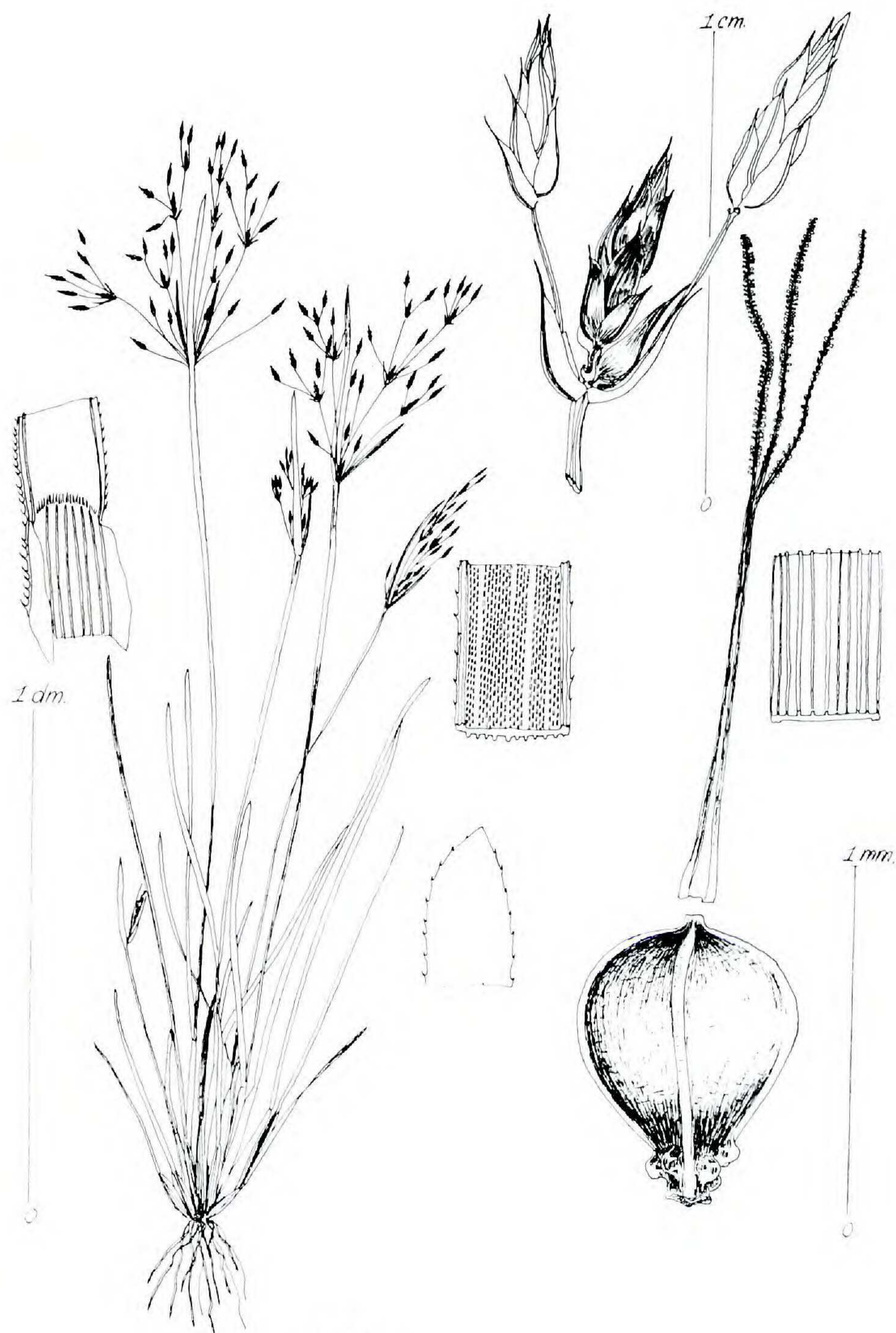


26

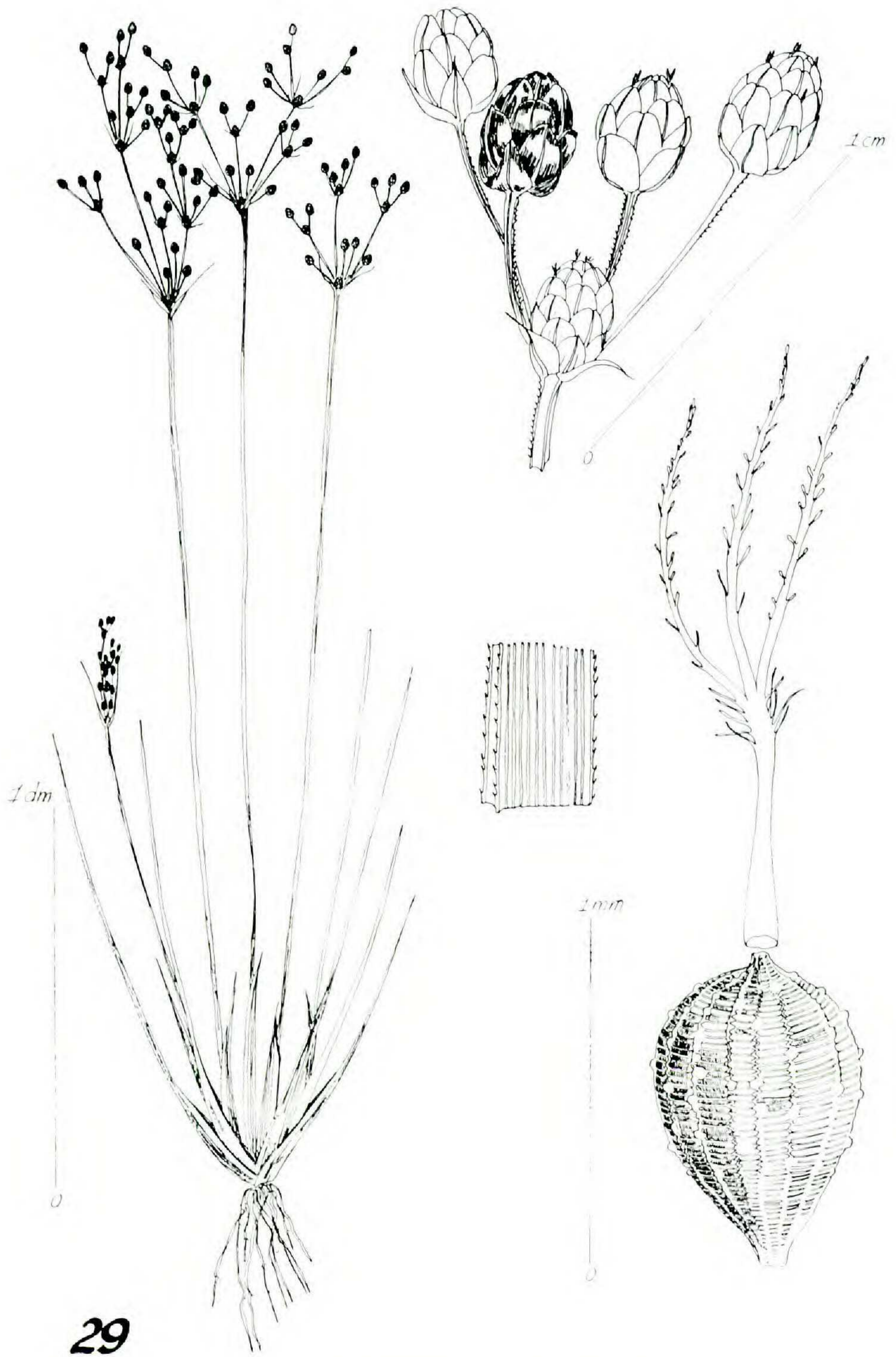
26. BULBOSTYLIS ANTILLANA



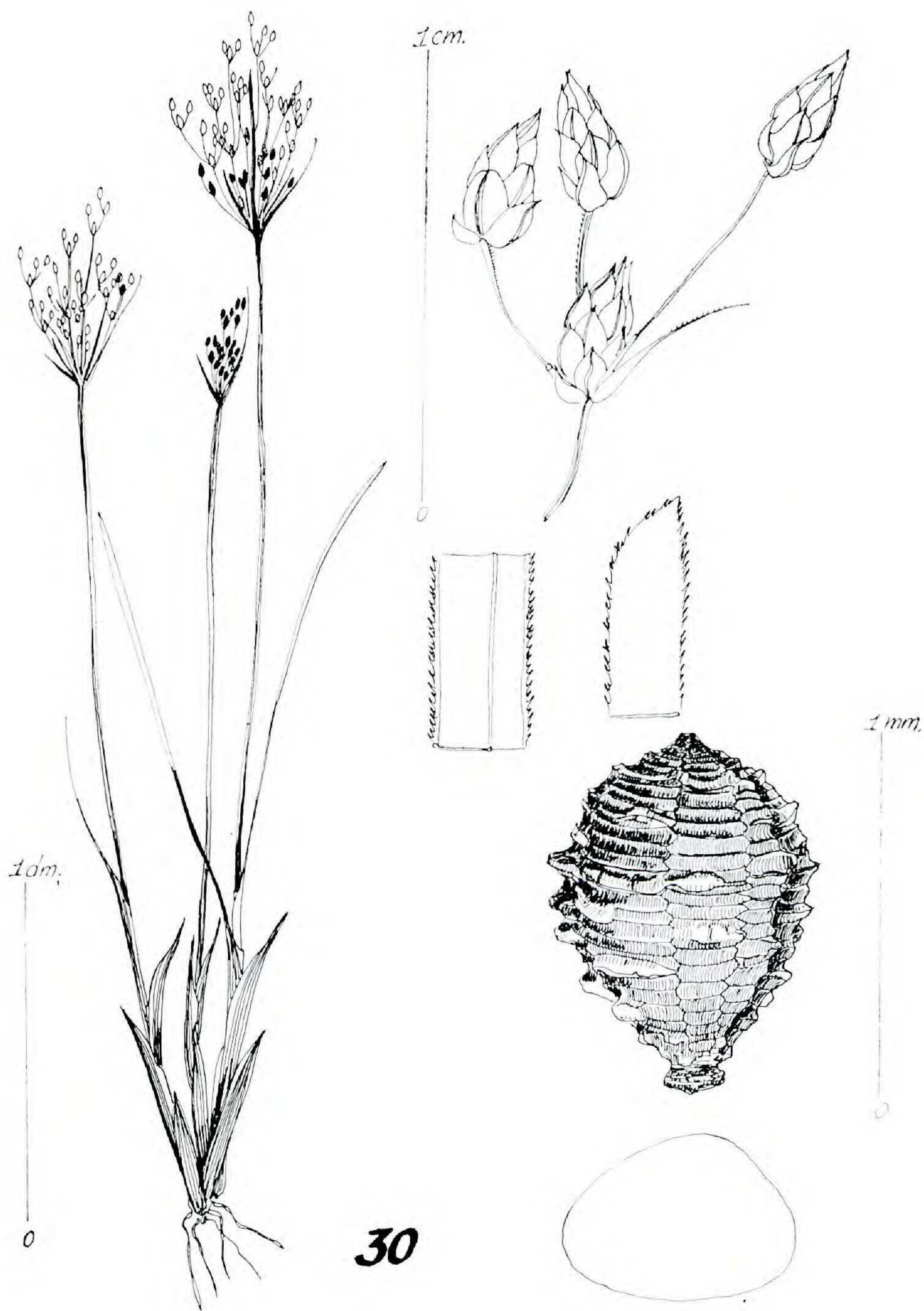
27. FIMBRISTYLIS COMPLANATA

**28**

28. FIMBRISTYLIS AUTUMNALIS

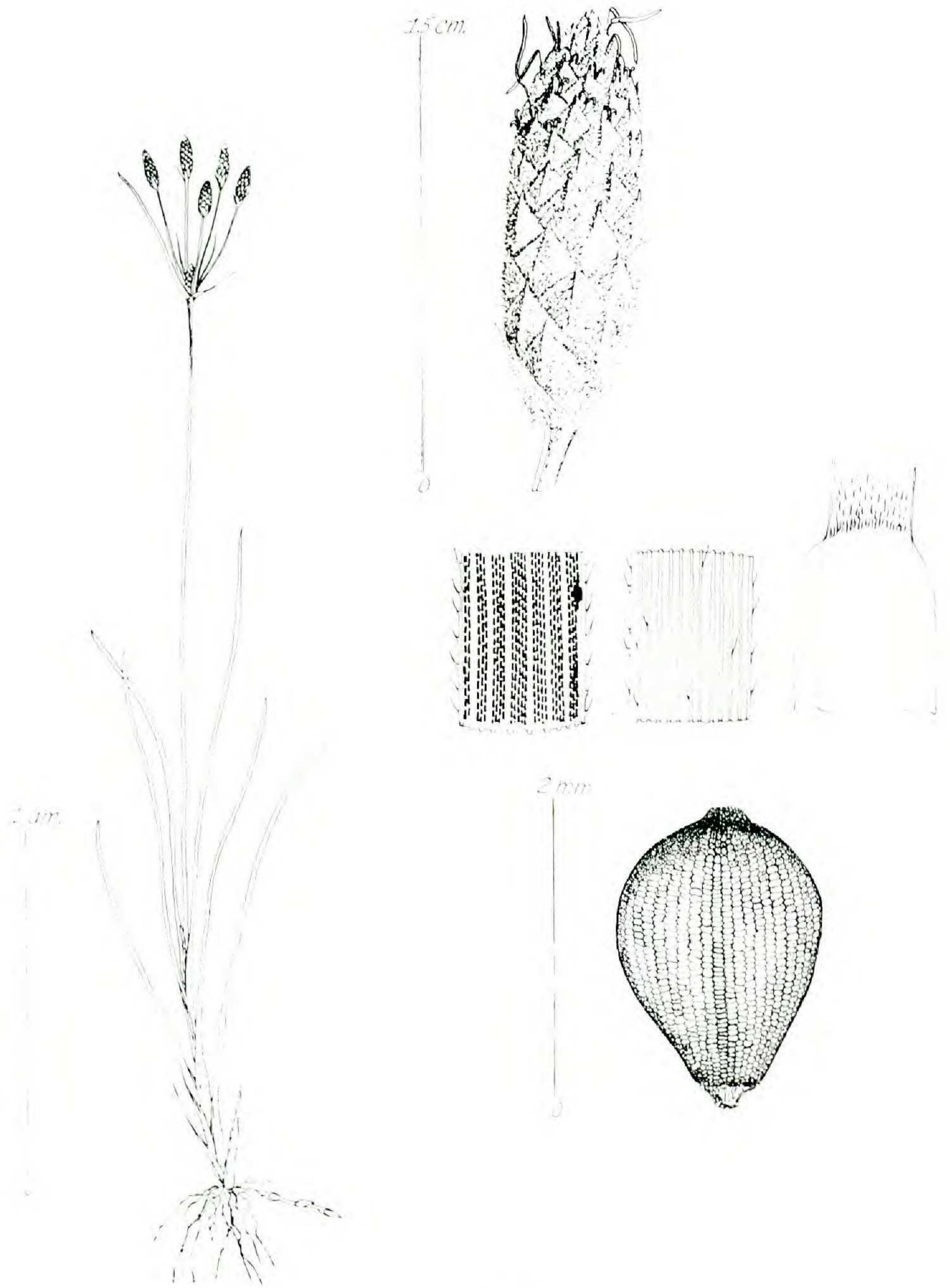


29. FIMBRISTYLIS MILIACEA



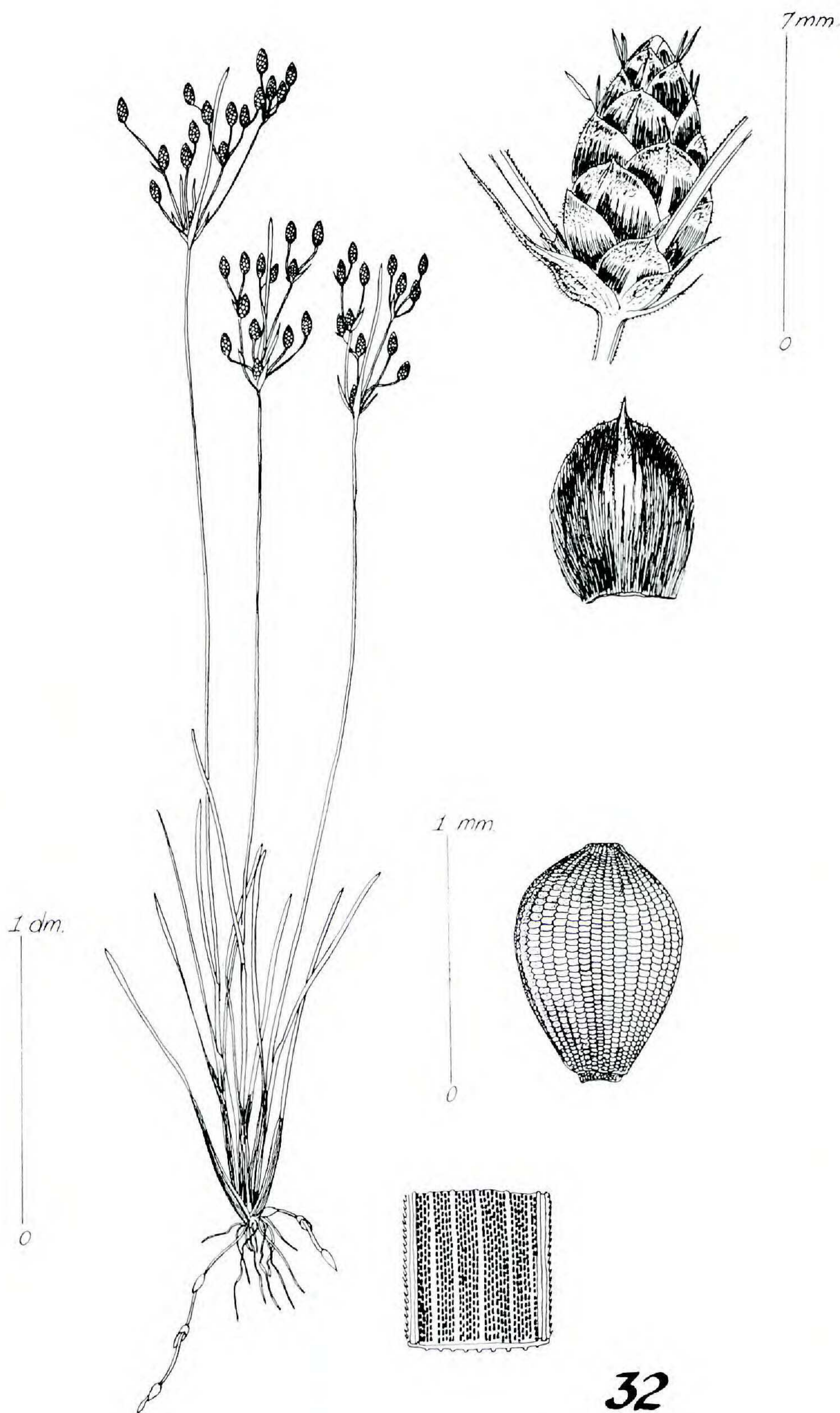
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30. FIMBRISTYLIS QUINQUANGULARIS

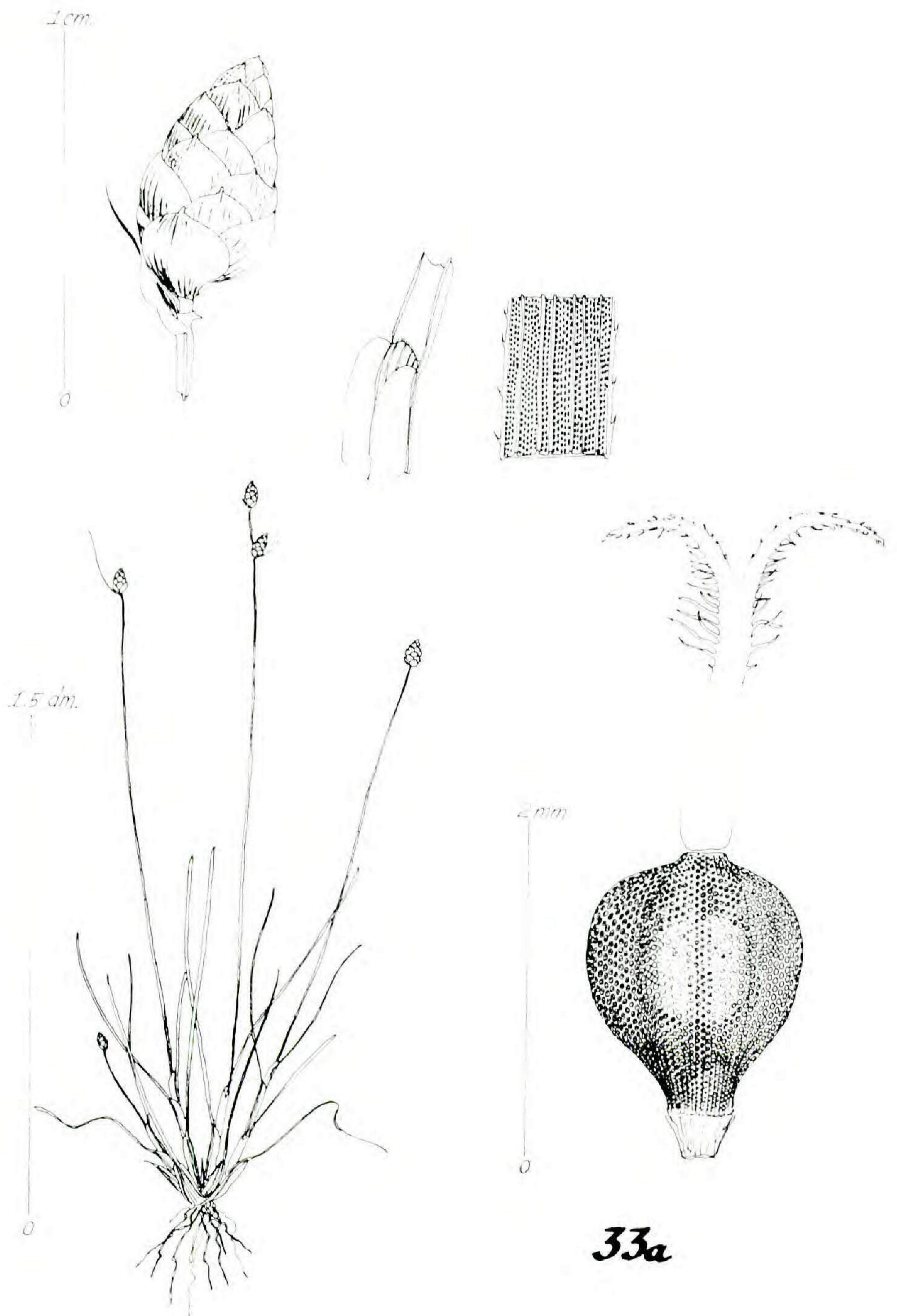


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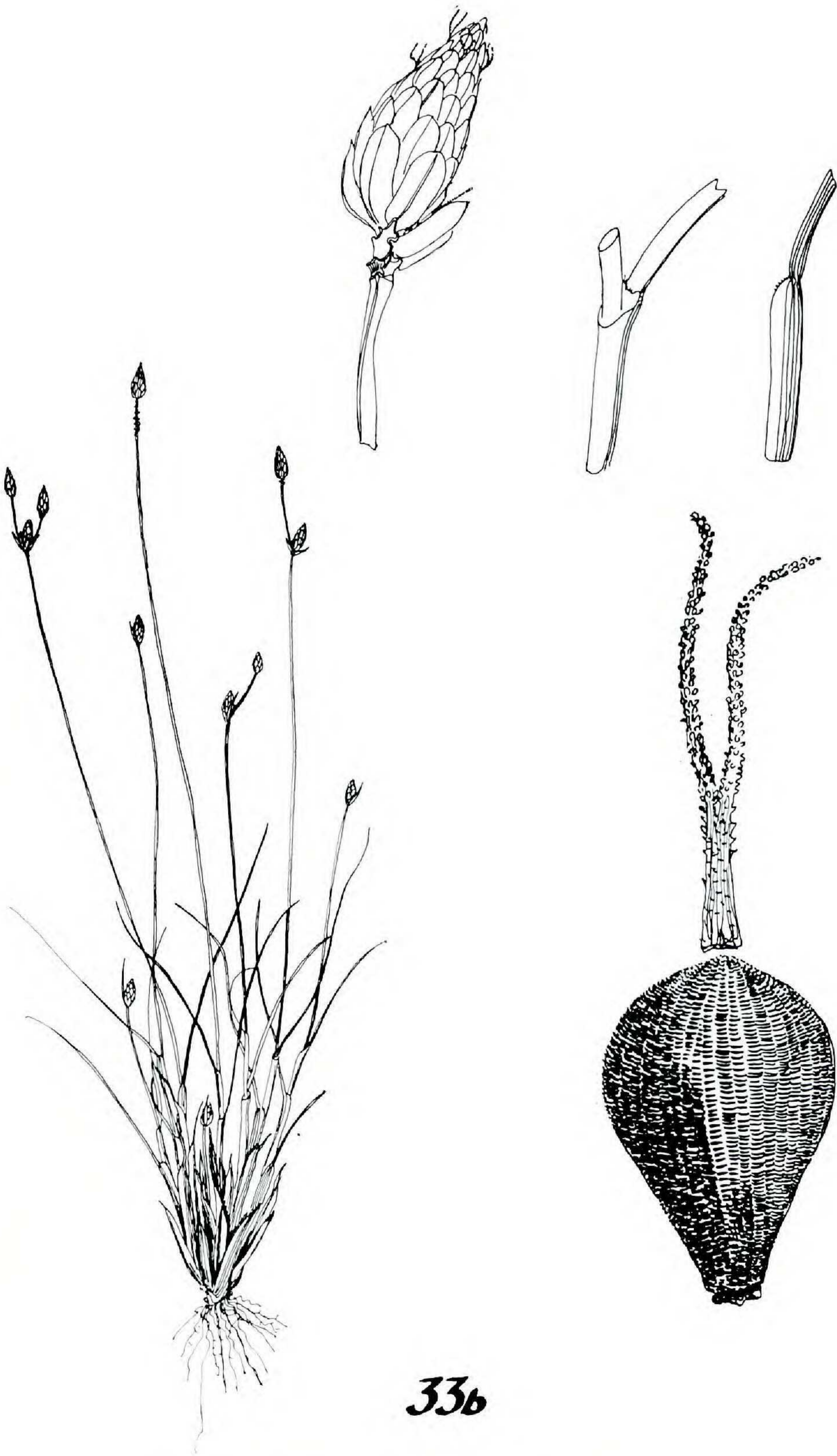
31. FIMBRISTYLIS THERMALIS



32. FIMBRISTYLIS CAROLINIANA



33a. FIMBRISTYLIS SCHOENOIDES



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33b. FIMBRISTYLIS POLYTRICHOIDES

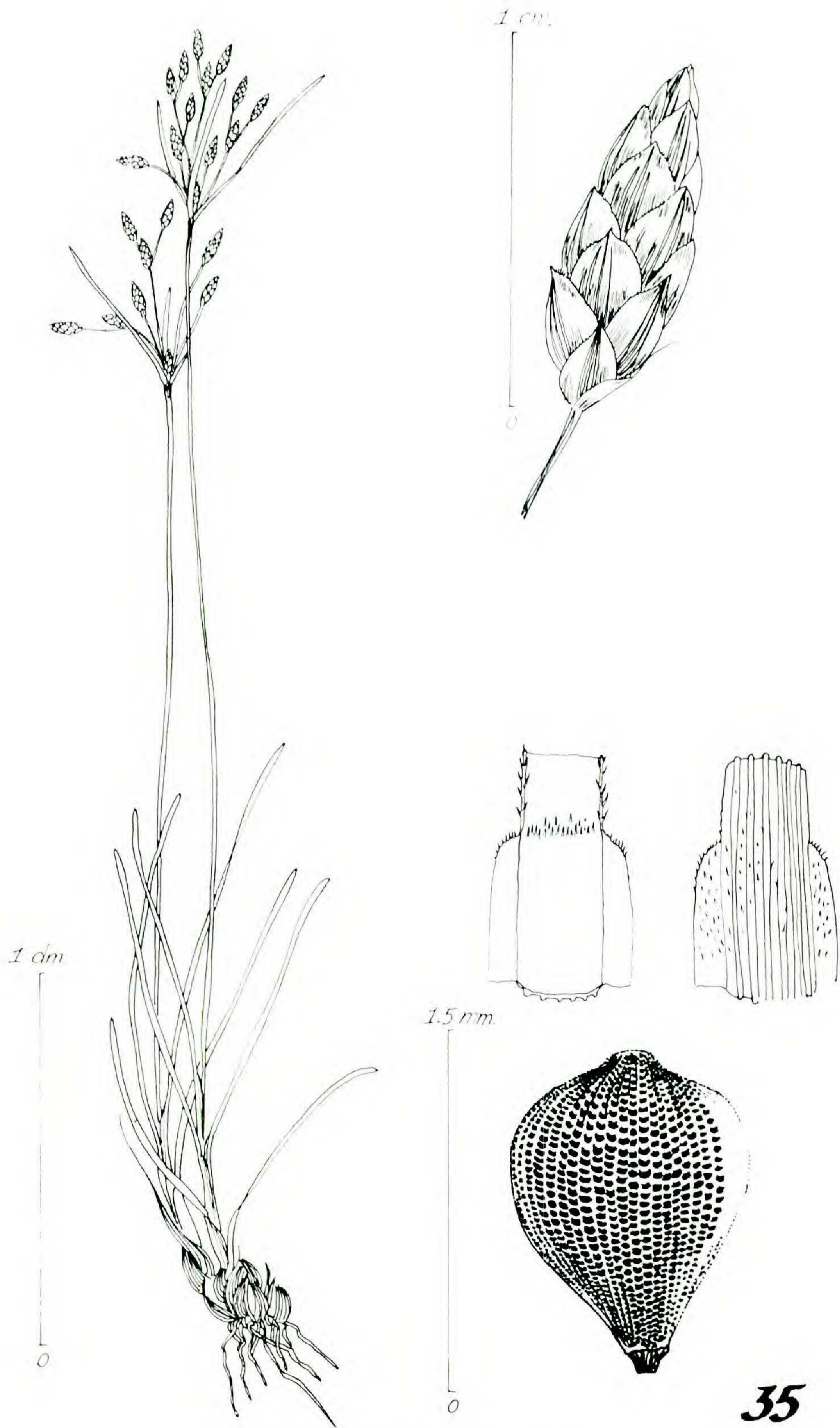


33c

33c. FIMBRISTYLIS TRISTACHYA

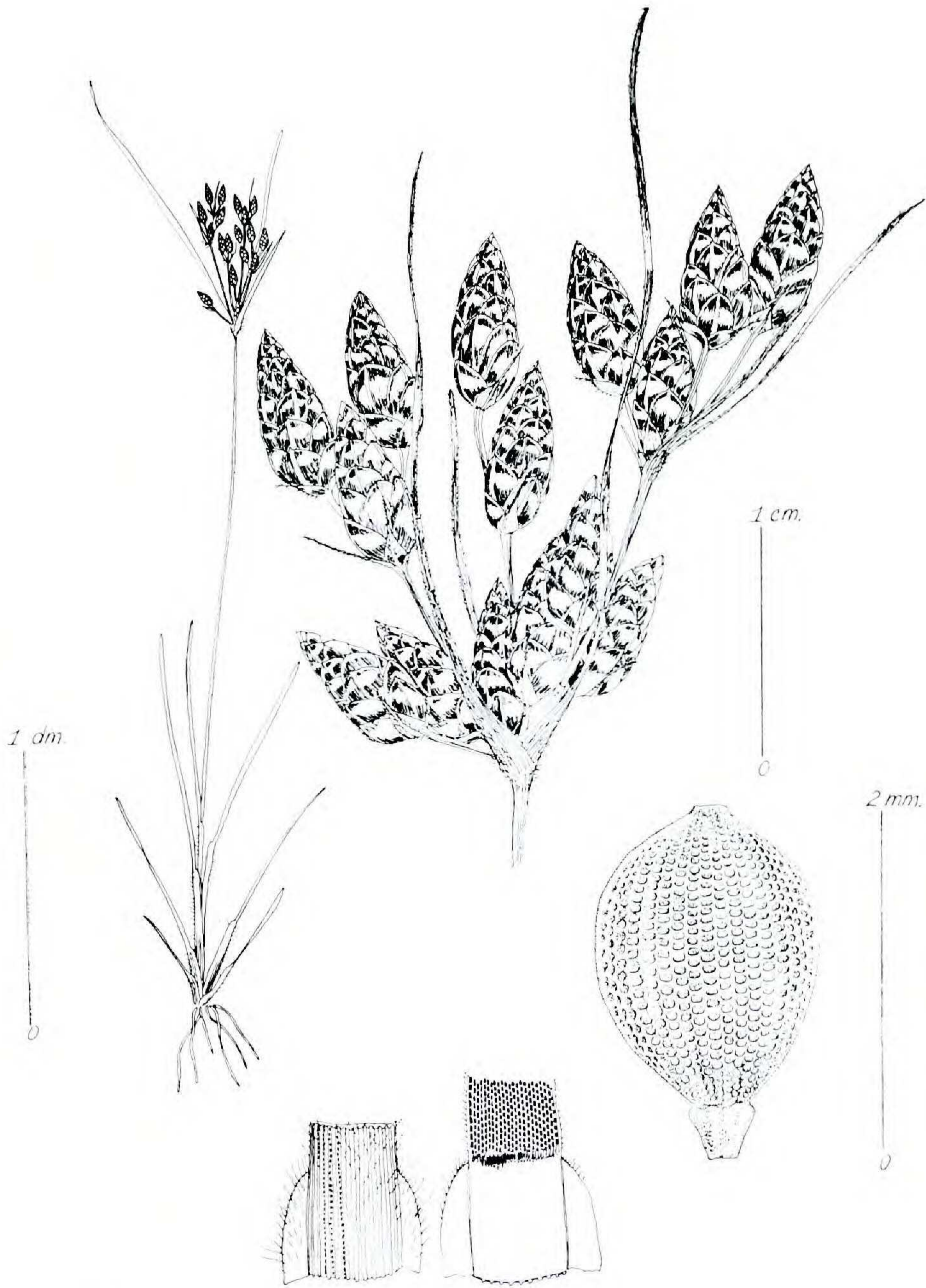


34. FIMBRISTYLIS FERRUGINEA

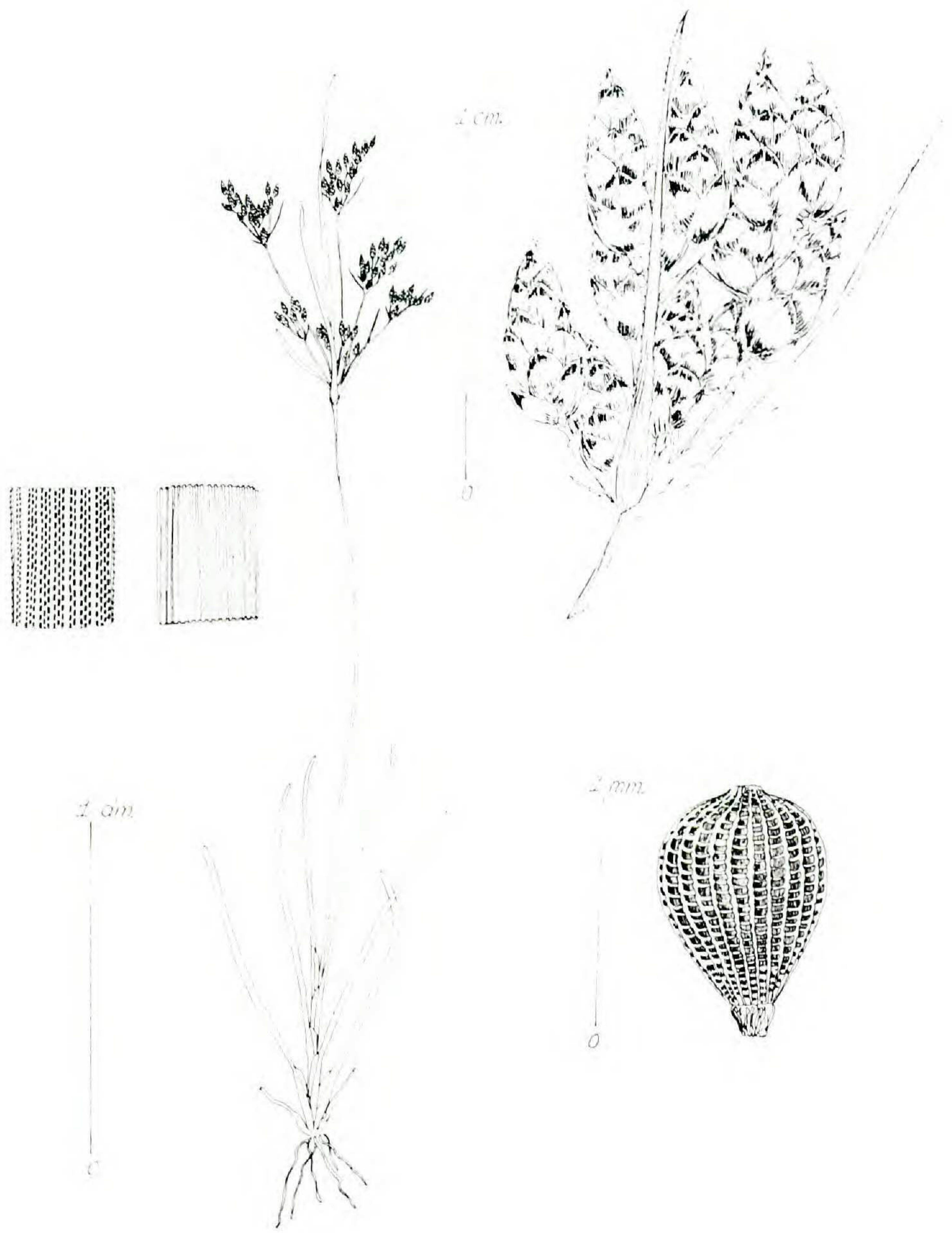


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35. FIMBRISTYLIS INAGUENSIS

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36. FIMBRISTYLIS TOMENTOSA



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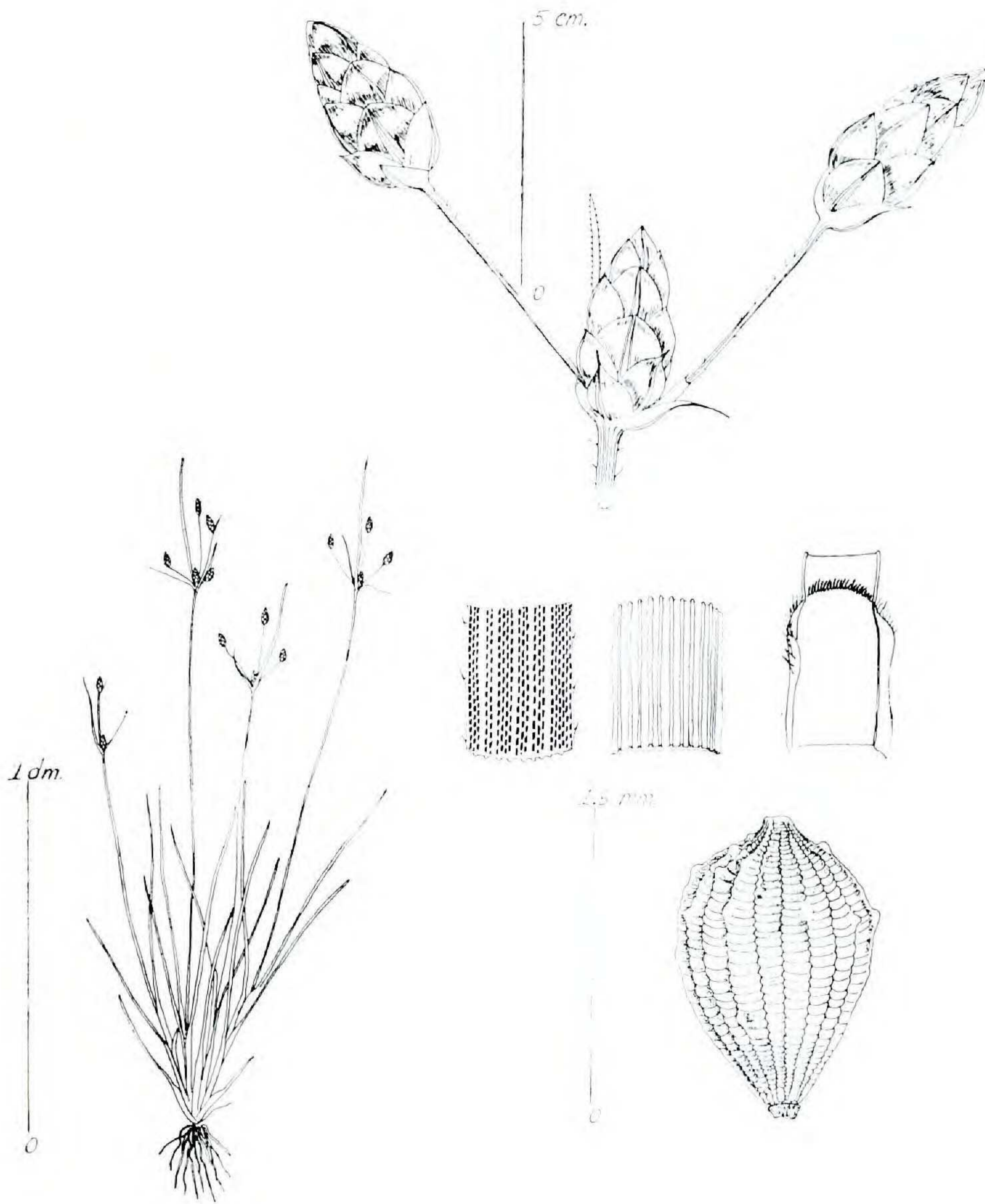
37a. FIMBRISTYLIS DICHOTOMA

**37b**

37b. FIMBRISTYLIS BISUMBELLATA

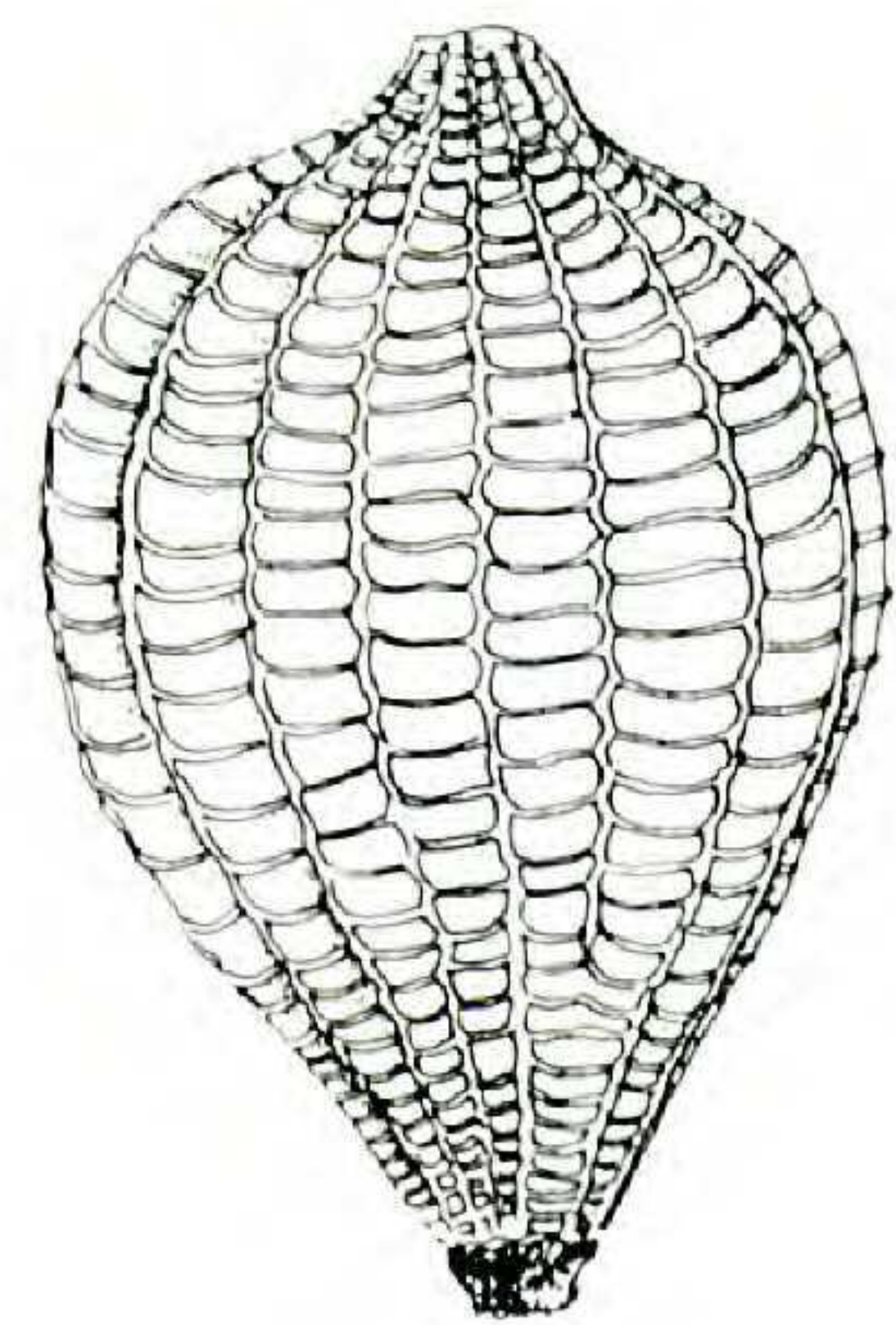
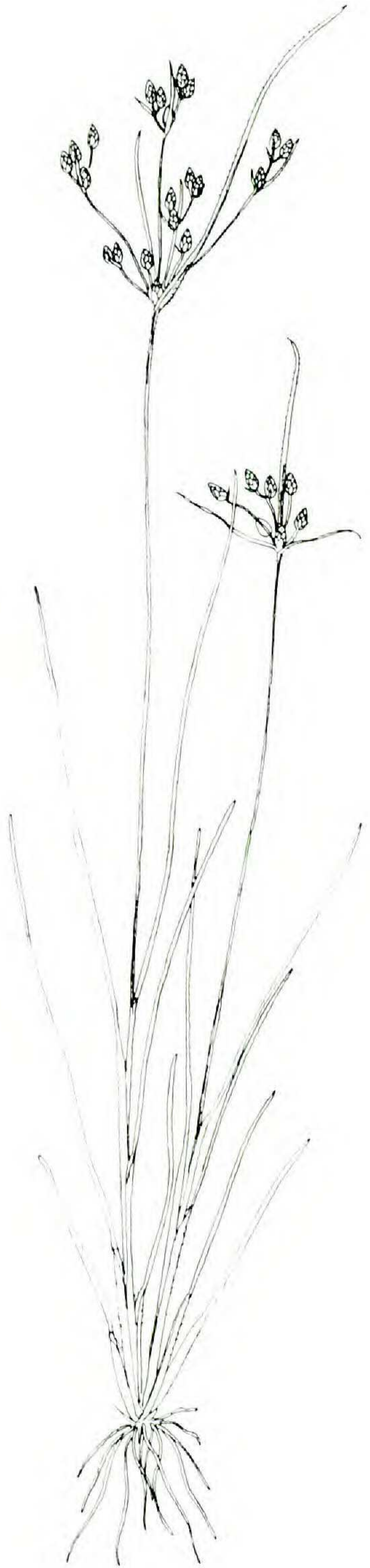


38. FIMBRISTYLIS DECIPIENS



39a

39a. FIMBRISTYLIS ANNUA



39b

39b. FIMBRISTYLIS ANNUA



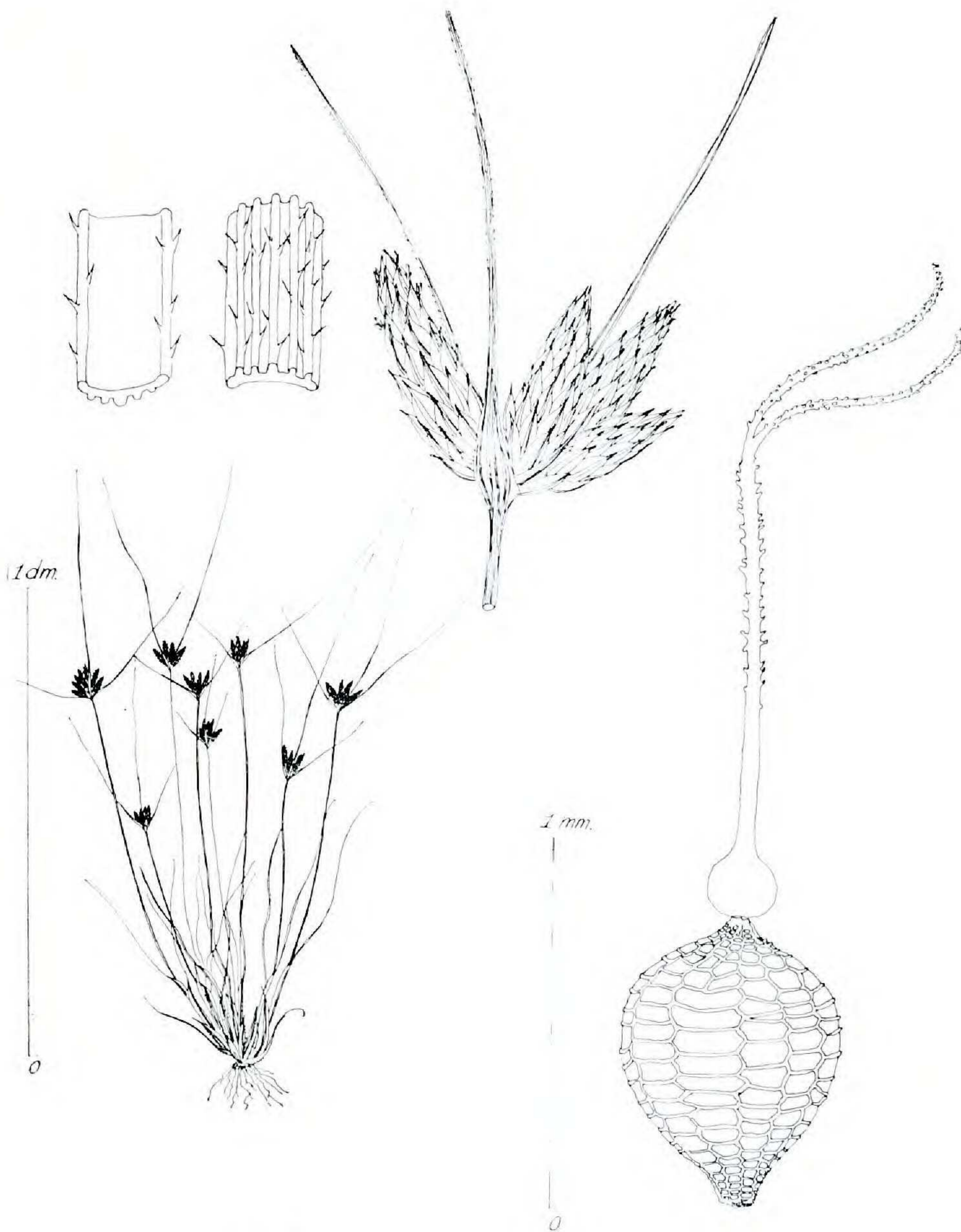
40a

40a. FIMBRISTYLIS SQUARROSA

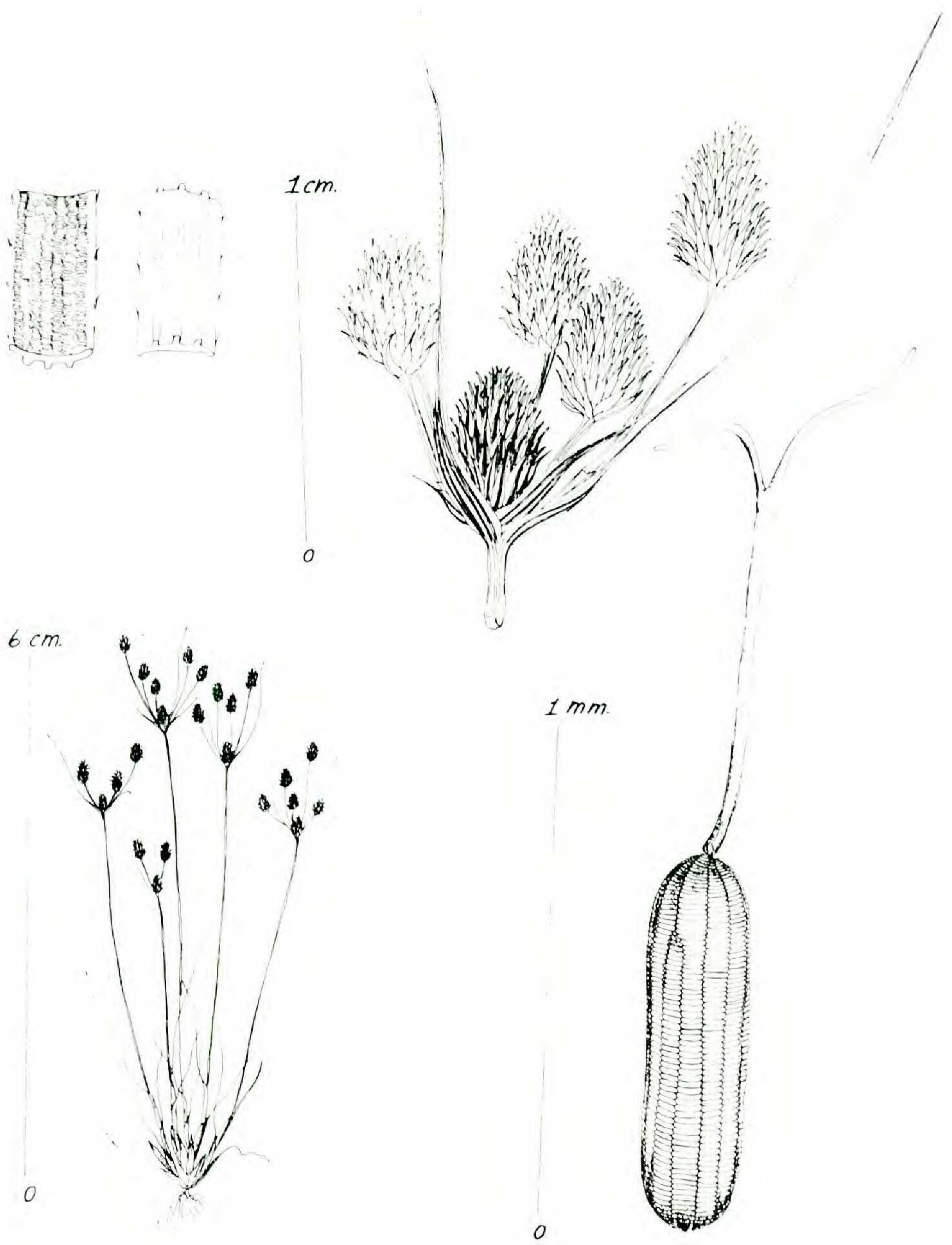


40b

40b. FIMBRISTYLIS AESTIVALIS

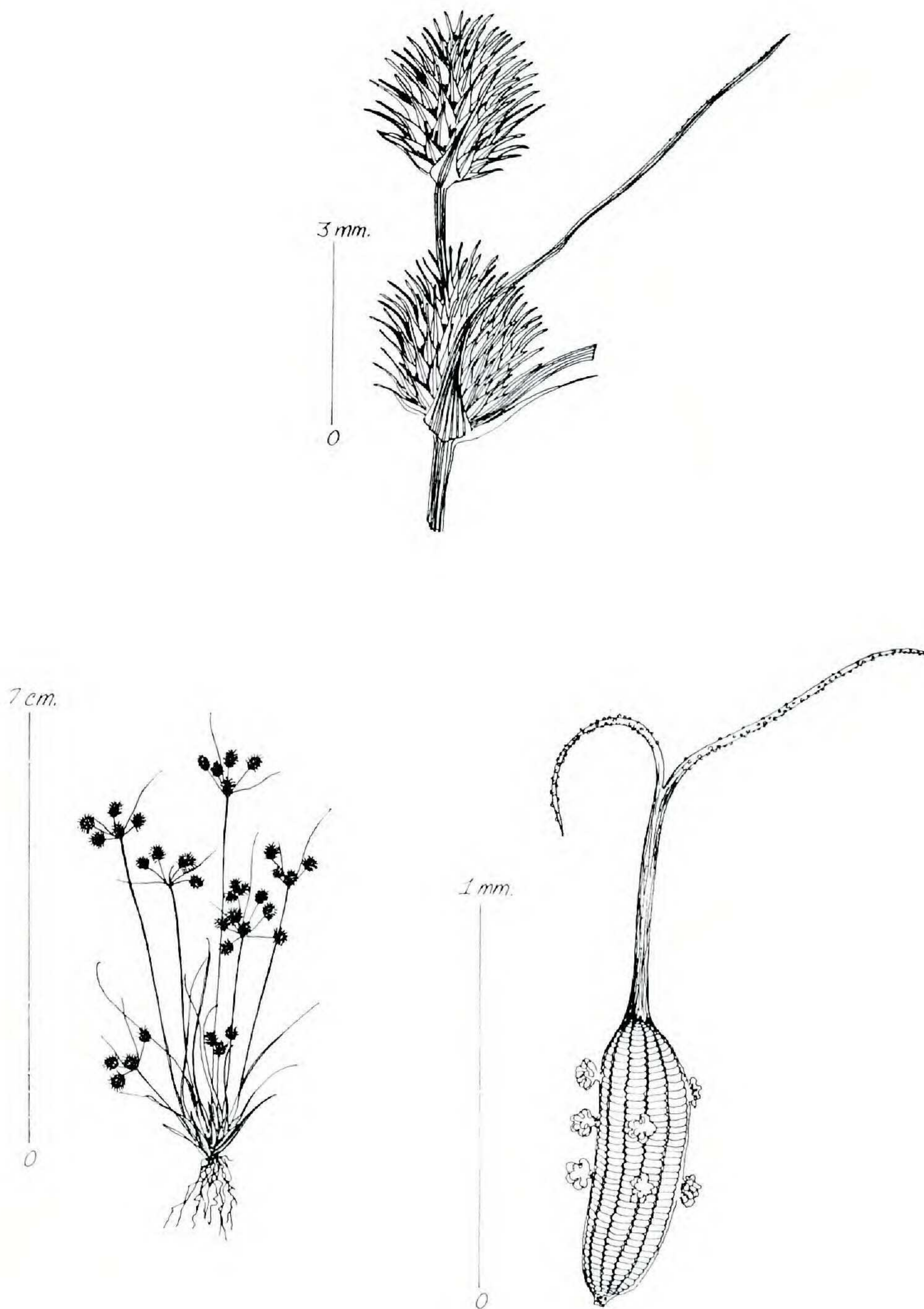
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41. FIMBRISTYLIS VAHLII

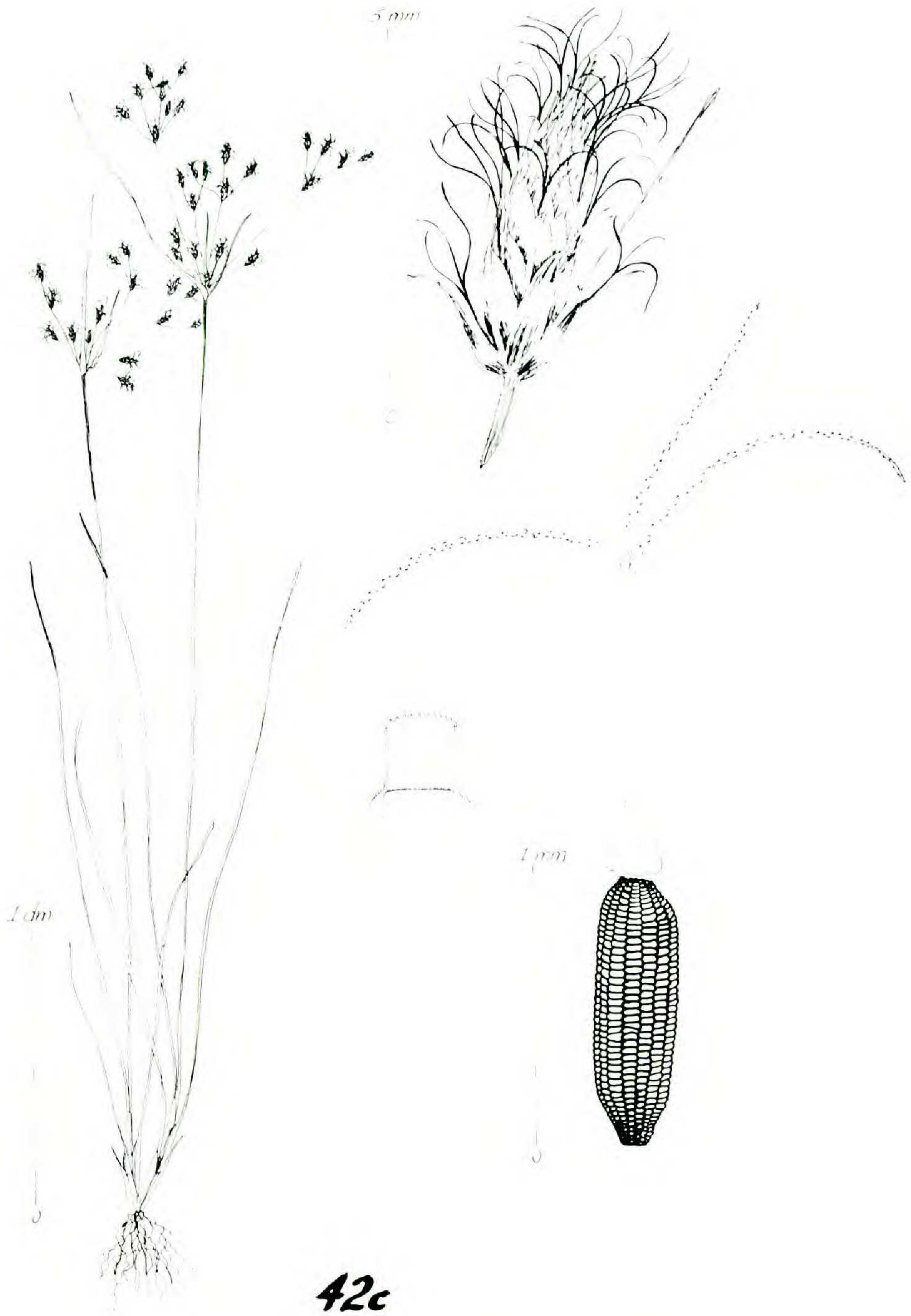


42a

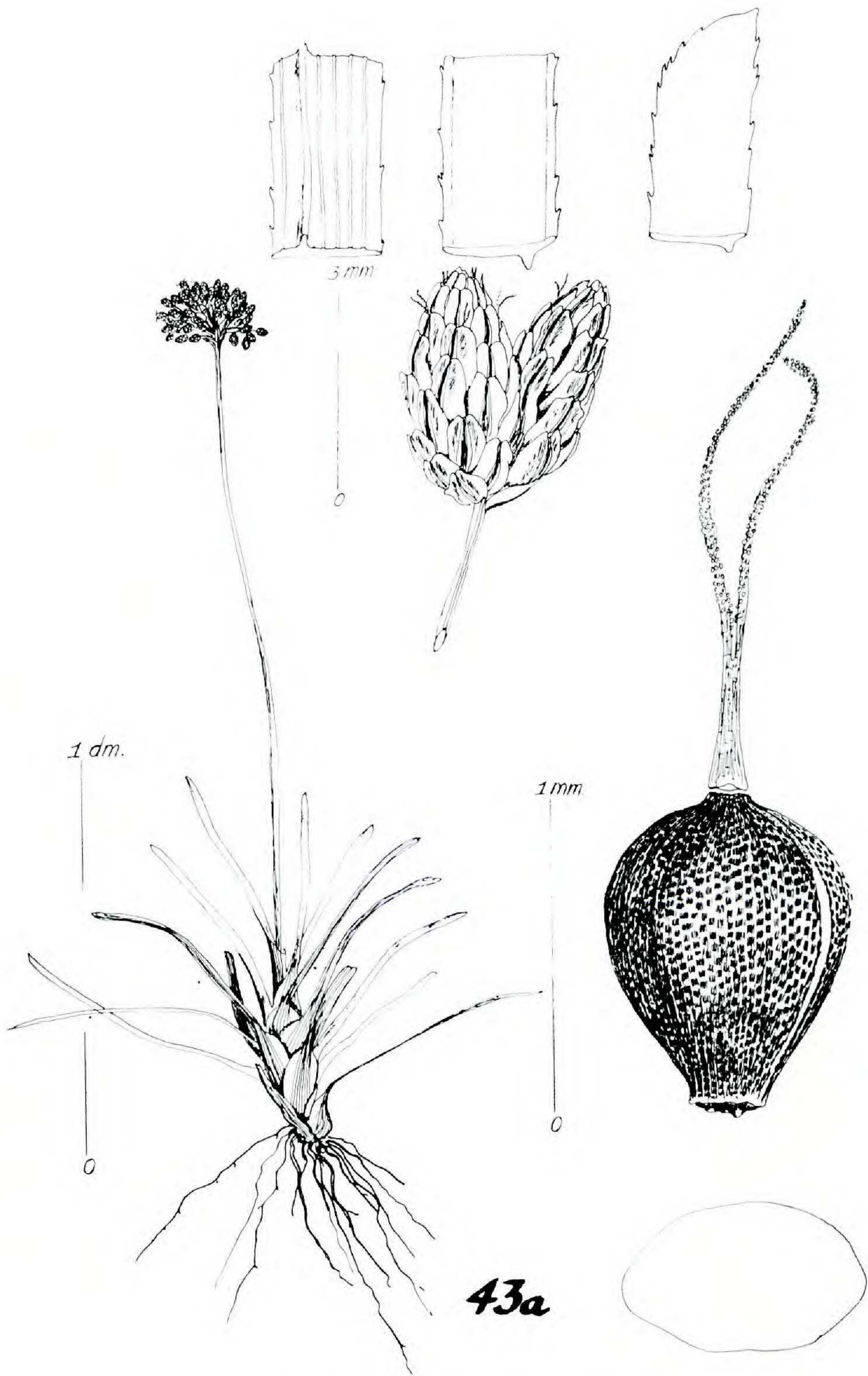
42a. FIMBRISTYLIS PERPUSILLA

**42b**

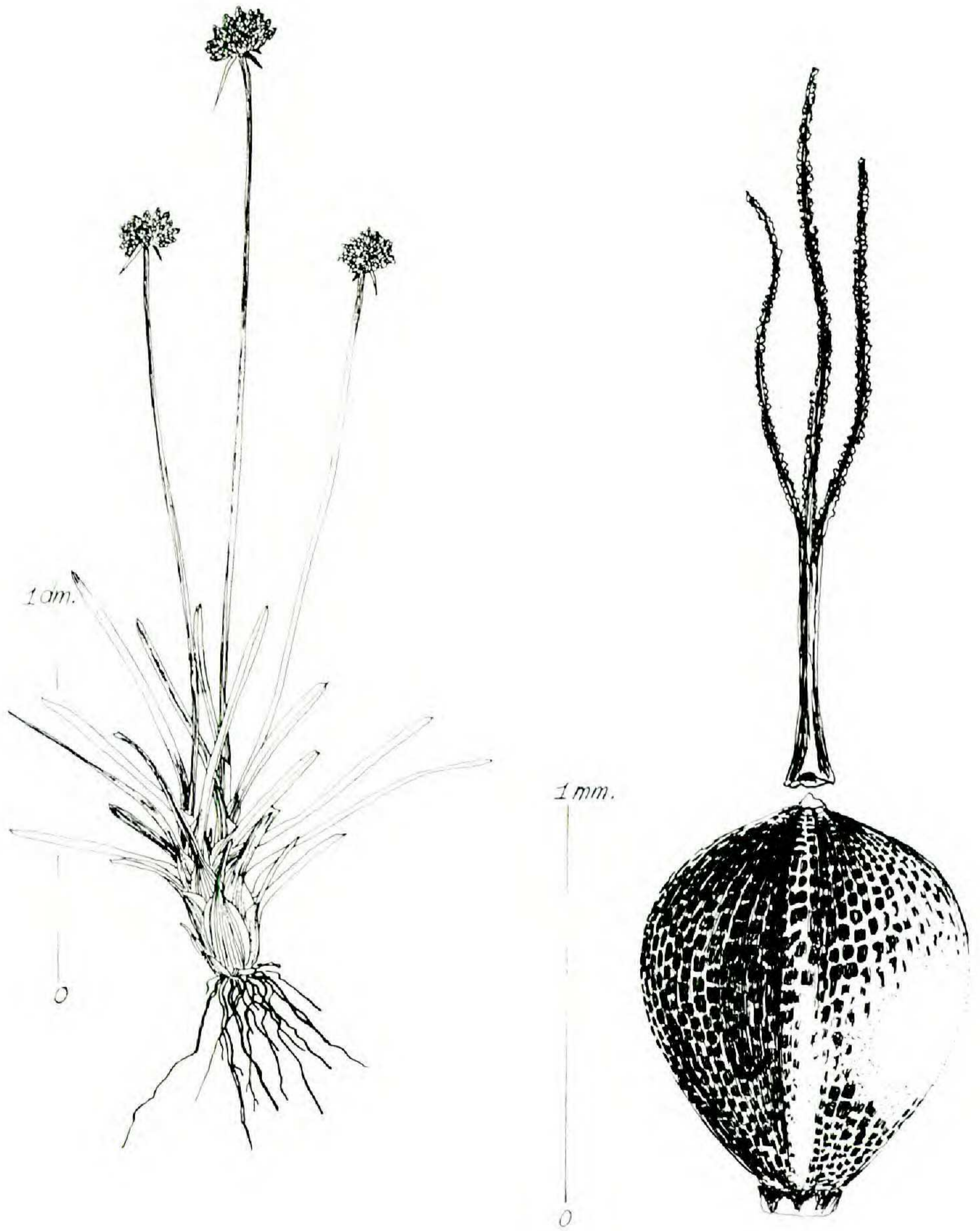
42b. FIMBRISTYLIS DIPSACEA



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42c. FIMBRISTYLIS STAUNTONI

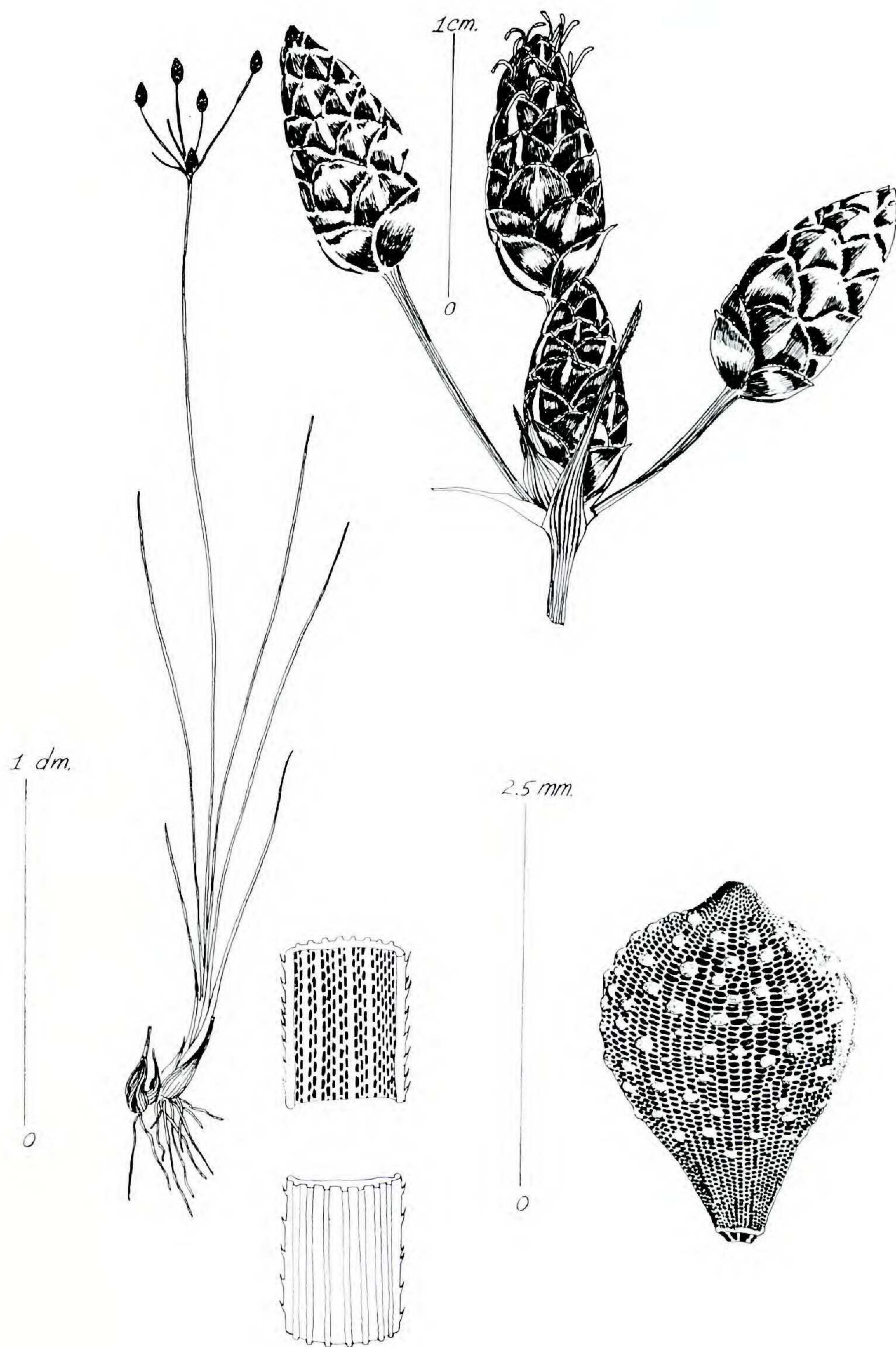


43a. FIMBRISTYLIS SPATHACEA



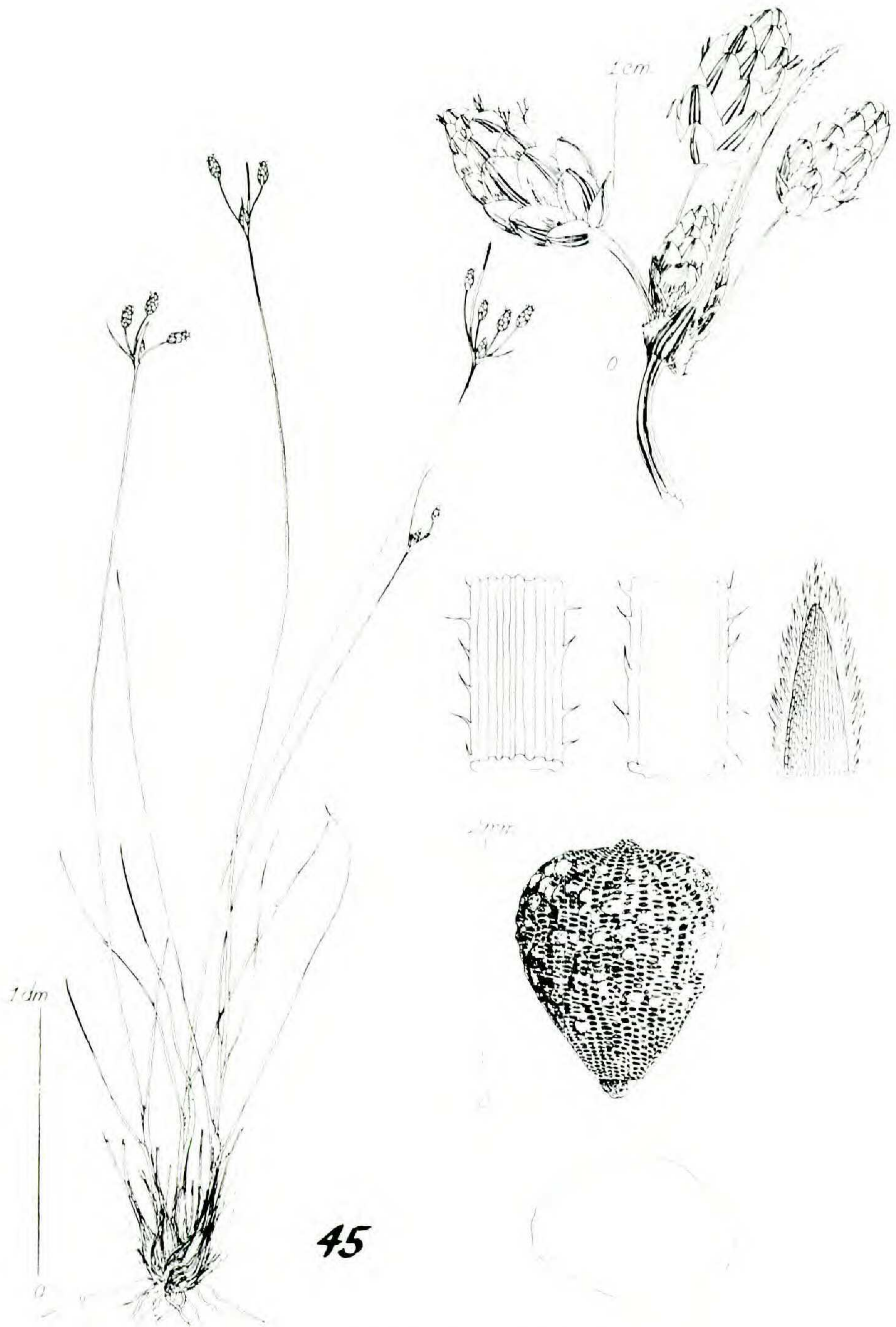
43b

43b. FIMBRISTYLIS CYMOSA

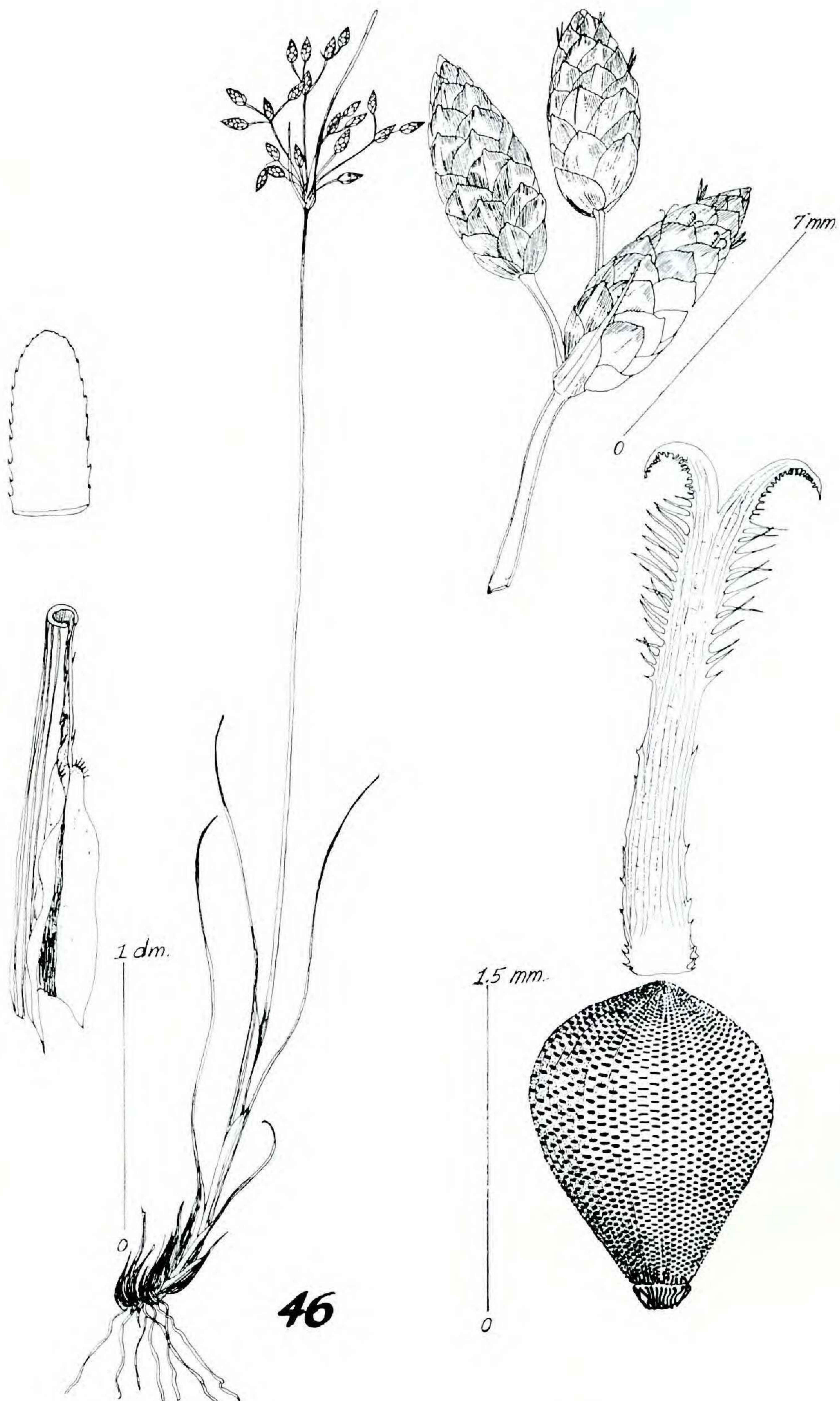


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44. FIMBRISTYLIS ARGILLICOLA



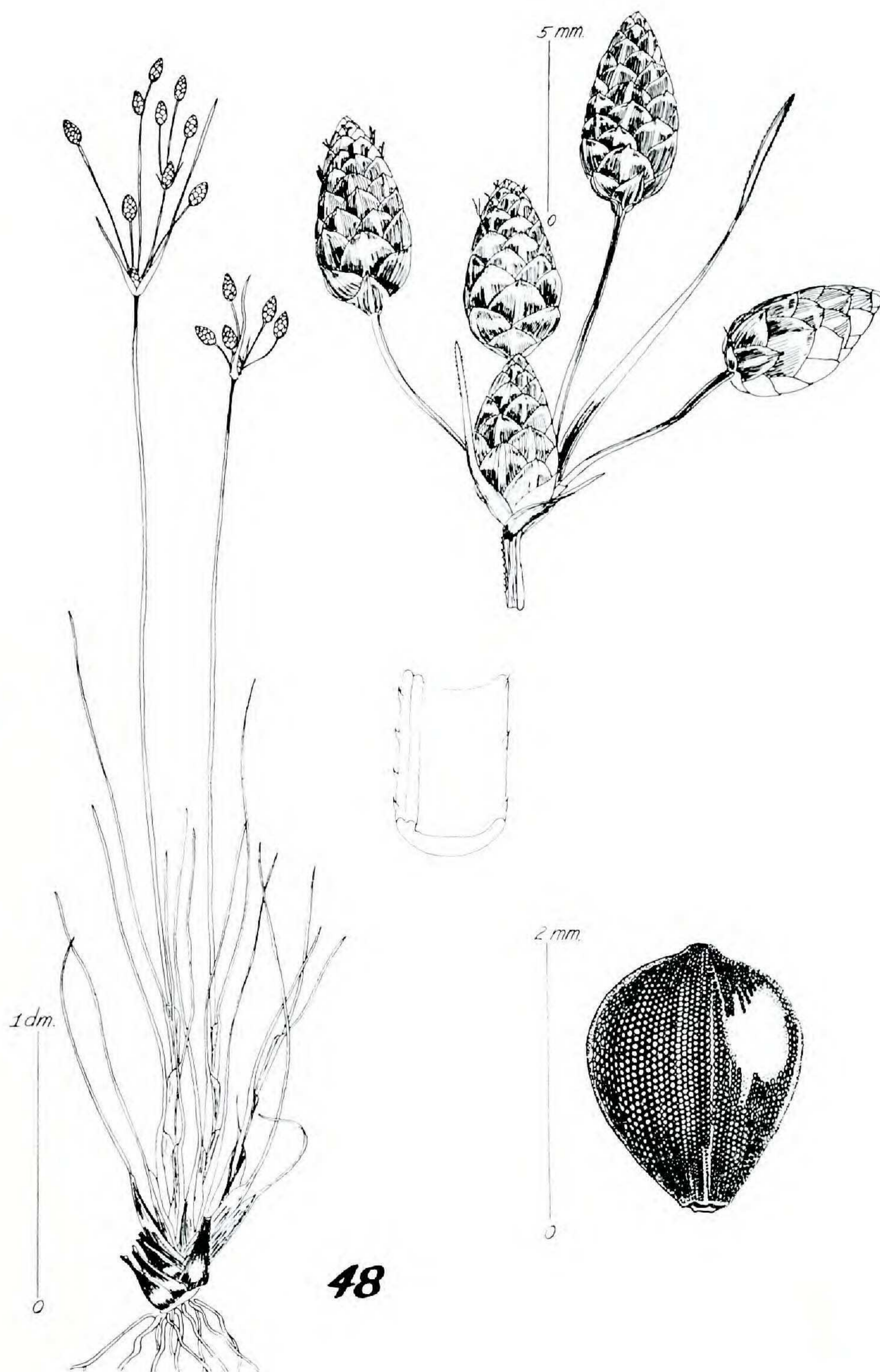
45. FIMBRISTYLIS PENTASTACHYA



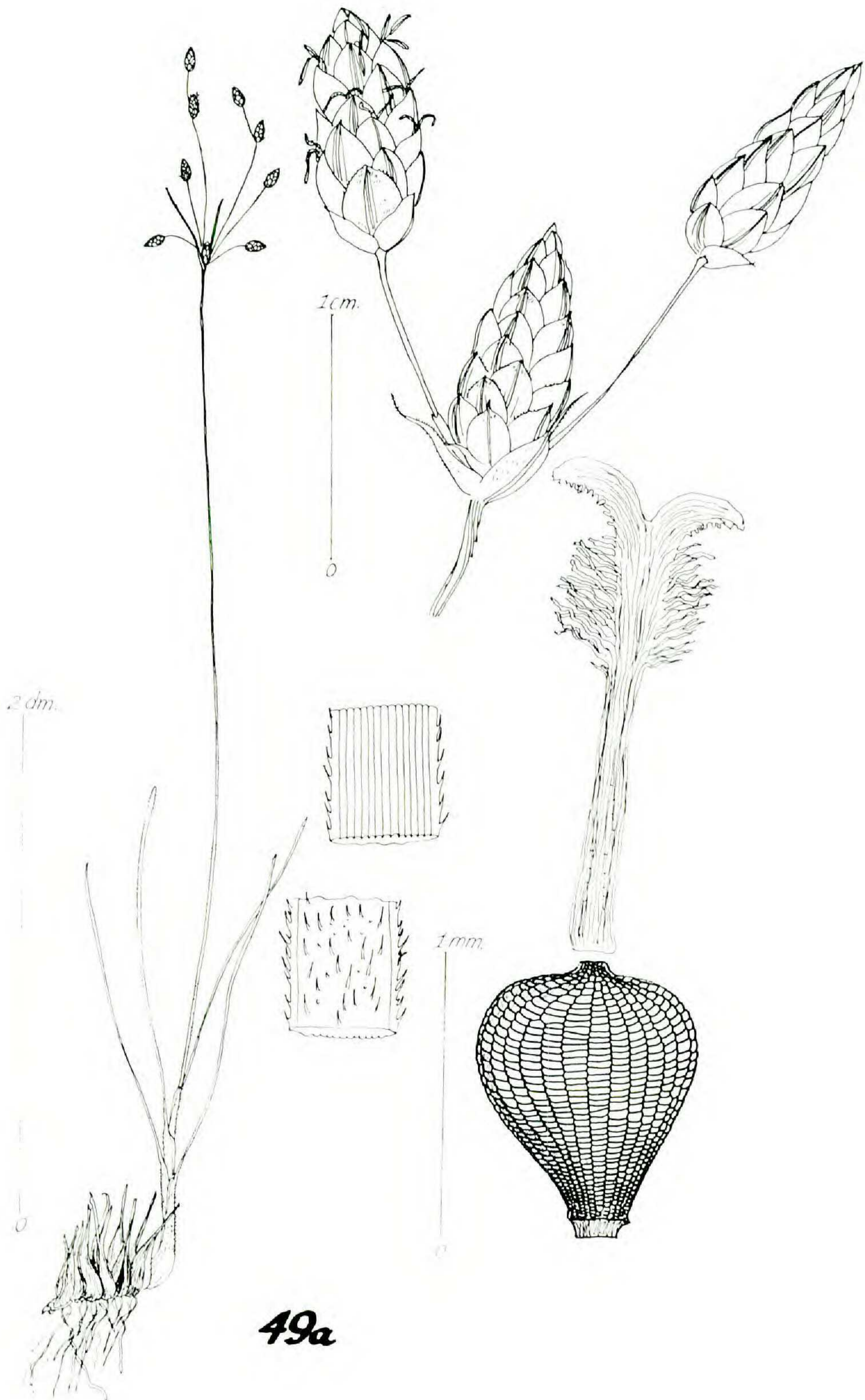
46. FIMBRISTYLIS PALLIDULA



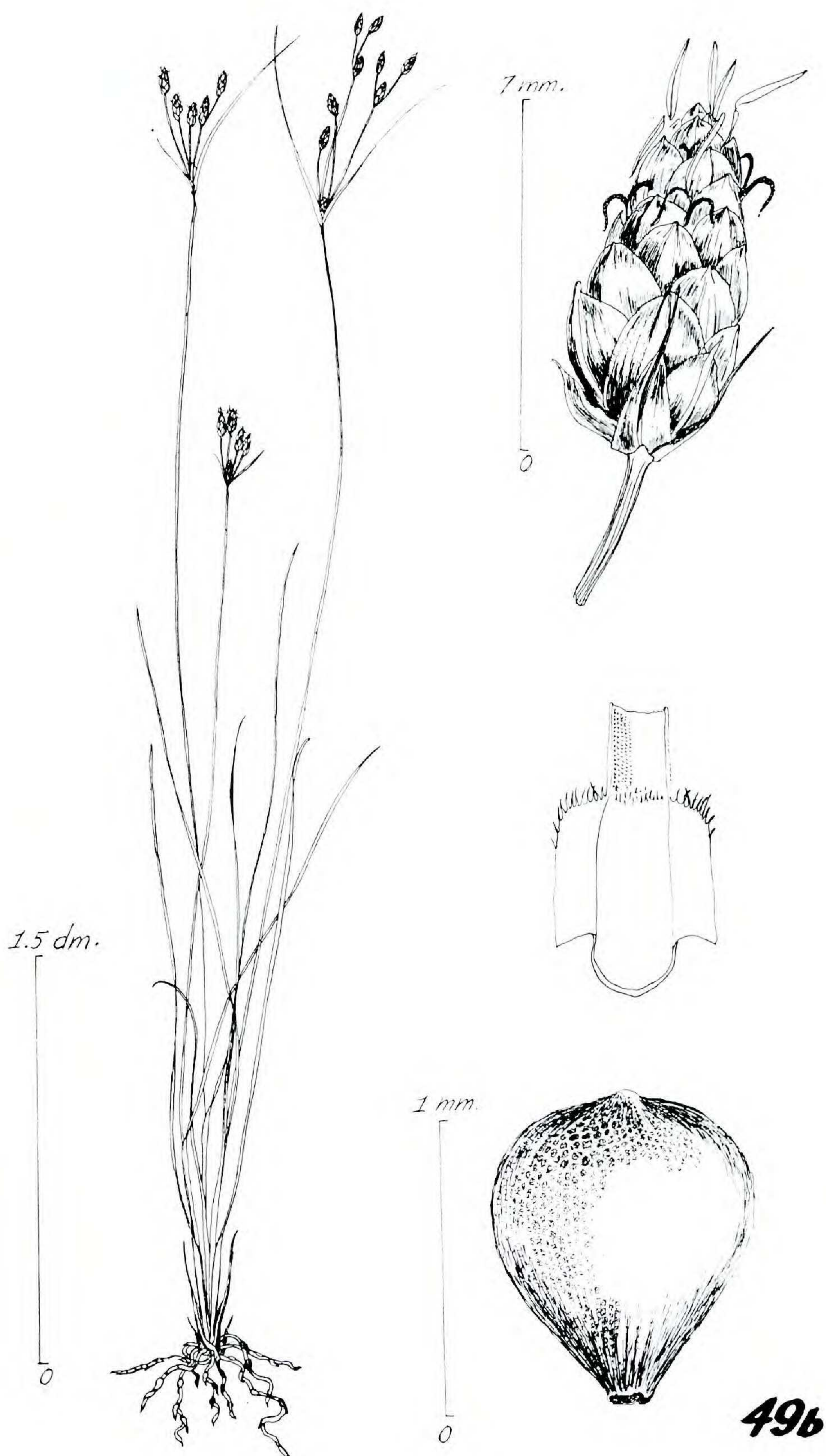
47. FIMBRISTYLIS SPADICEA



48. FIMBRISTYLIS CASTANEA



49a. FIMBRISTYLIS PUBERULA VAR. PUBERULA



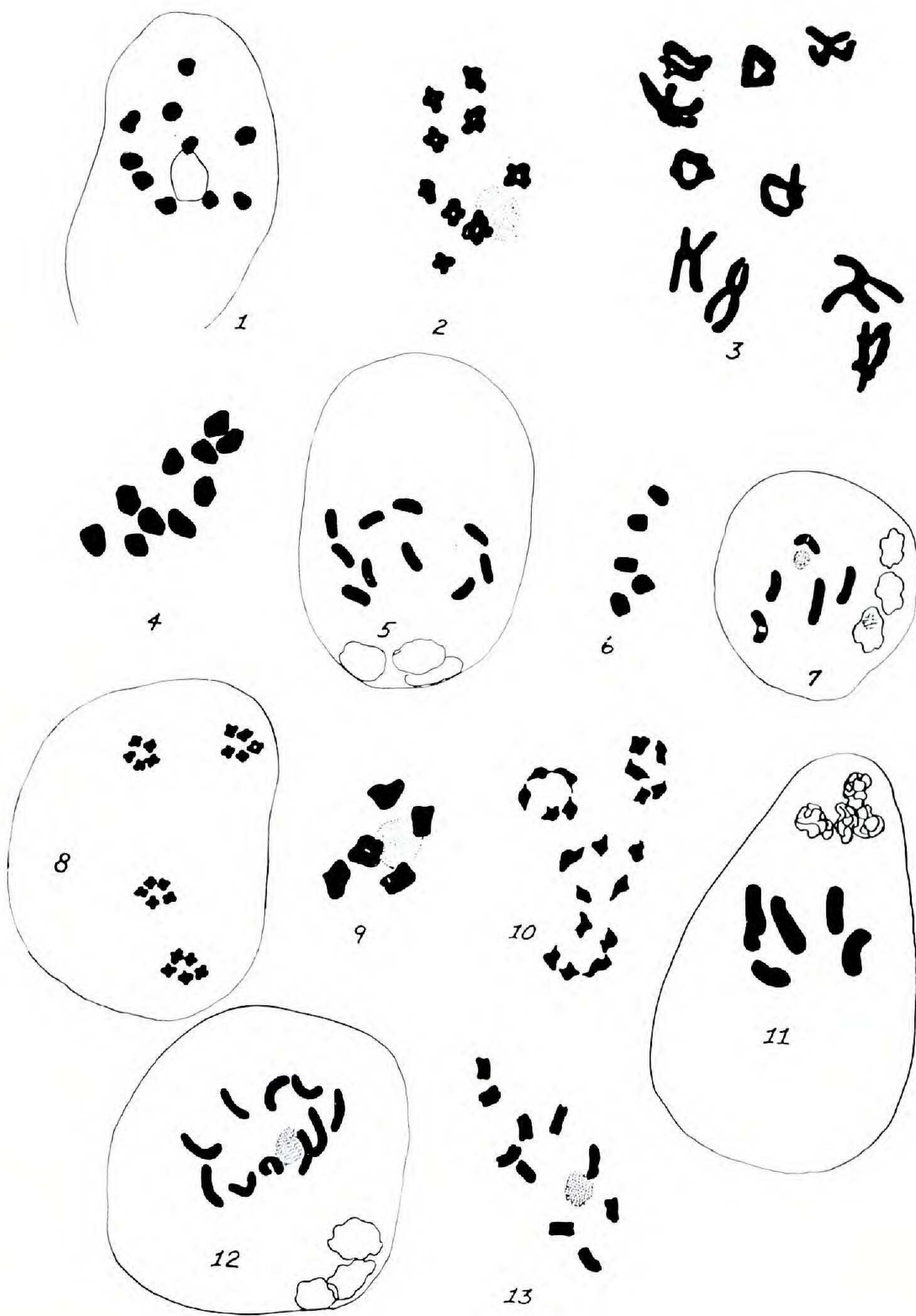
49b. FIMBRISTYLIS PUBERULA VAR. INTERIOR

MICROSPOROGENESIS IN ABILDGAARDIA. 1. *A. ovata* (Kral 18128, prophase 1). 2. *A. ovata* (Kral 27767, prophase 1). 3. *A. mexicana* (Kral 27695, prophase 1). 4. *A. mexicana* (Kral 27685, metaphase 1). 5. *A. mexicana* (Kral 27694, 3rd division).

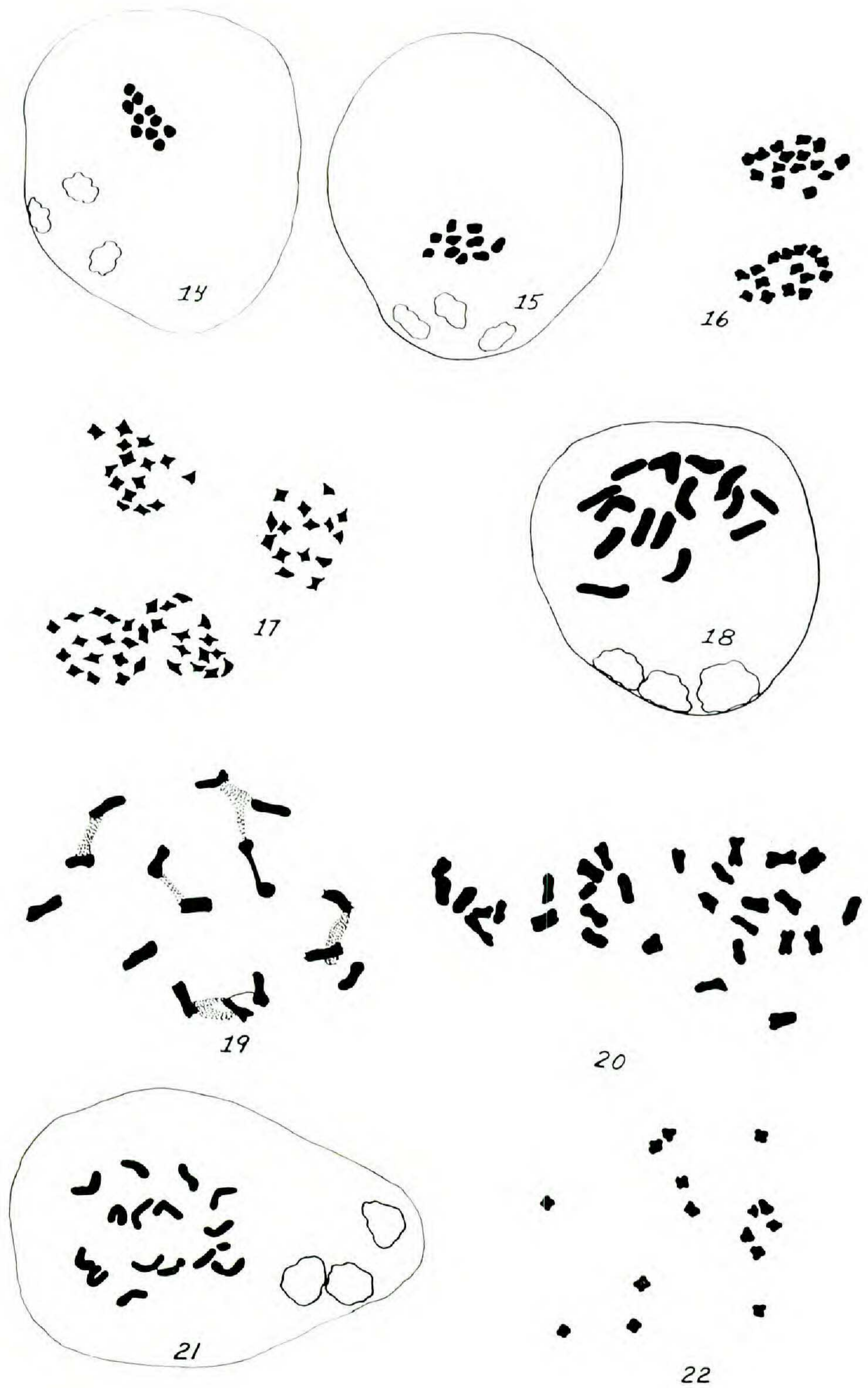
MICROSPOROGENESIS IN BULBOSTYLIS. 6. *B. barbata* (Kral 28602, metaphase 1). 7. *B. barbata* (Kral 28602, 3rd division). 8. *B. barbata* (Kral 27155, end of 2nd division). 9. *B. pubescens* (Kral 27509, prophase 1). 10. *B. pubescens* (Kral 27504, end of 2nd division). 11. *B. pubescens* (Kral 27739, 3rd division). 12. *B. pubescens* (Kral 27738, 3rd division). 13. *B. pubescens* (Kral 27738, prophase 1). 14. *B. funckii* (Kral 27643, 3rd division). 15. *B. funckii* (Kral 27643, 3rd division). 16. *B. hirta* (Kral 27553, prophase 2). 17. *B. hirta* (Kral 27540, end of 2nd division). 18. *B. hirta* (Kral 27553, 3rd division). 19. *B. warei* (Kral 27335, prophase 1). 20. *B. warei* (Kral 28751, prophase 1). 21. *B. warei* (Kral 22378, 3rd division). 22. *B. stenophylla* (Kral 23039, prophase 1).

23. *B. stenophylla* (Kral 23039, 3rd division). 24. *B. trilobata* (Kral 25329, 3rd division). 25. *B. trilobata* (Kral 27733, 3rd division). 26. *B. vestita* (Kral 27783, prophase 1). 27. *B. junciformis* (Kral 27778, 3rd division). 28. *B. junciformis* (Kral 27796, prophase 1). 29. *B. ciliatifolia* var. *coarctata* (Kral 27187, prophase 1). 30. *B. juncoides* (Kral 27696, prophase 1).

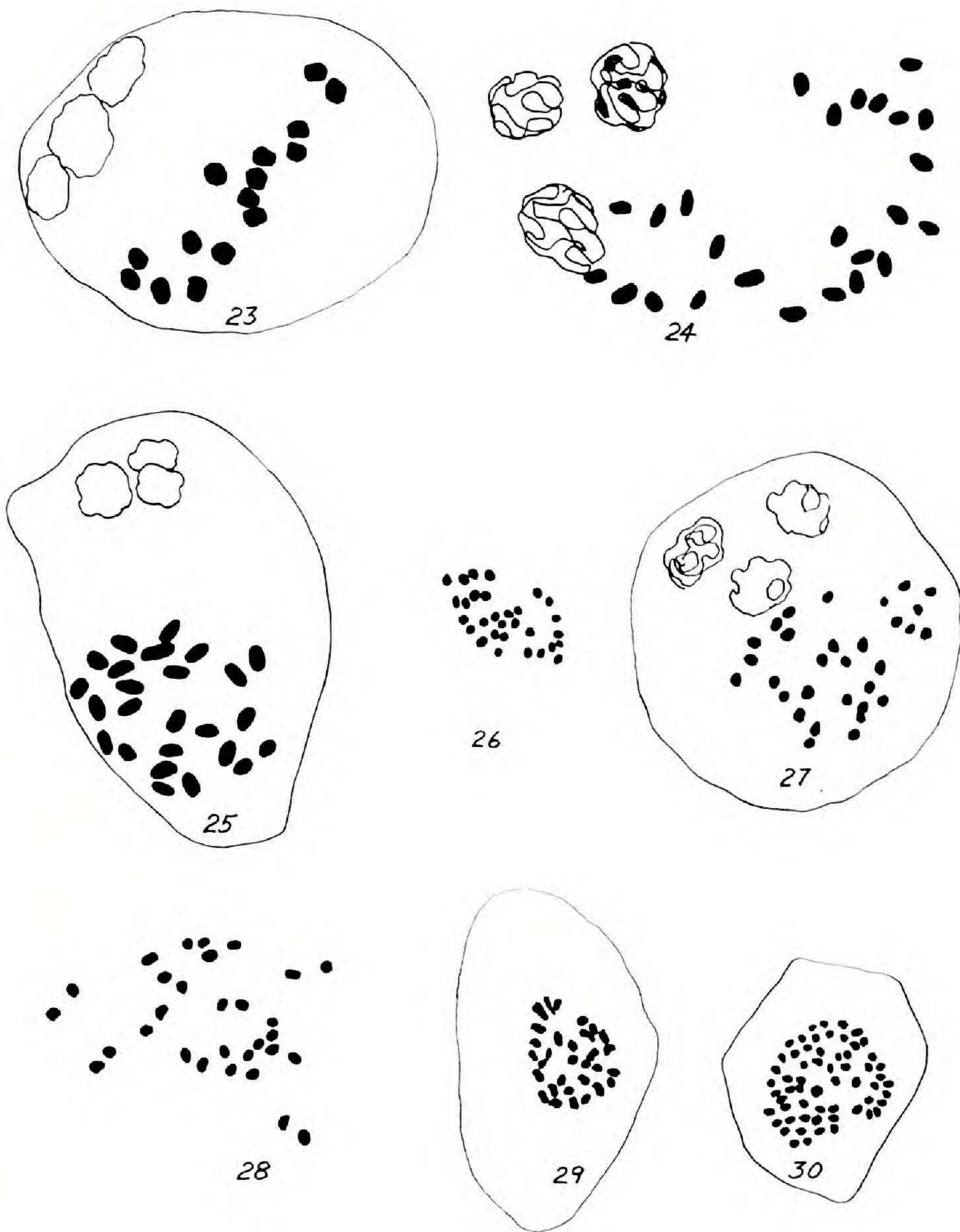
MICROSPOROGENESIS IN FIMBRISTYLIS. 31. *F. complanata* (Kral 25456, prophase 1). 32. *F. complanata* (Kral 25456, prophase 1). 33. *F. complanata* (Kral 27561, 3rd division). 34. *F. complanata* (Kral 27587, end of 3rd division). 35. *F. autumnalis* (Kral 20798, end of 2nd division). 36. *F. autumnalis* (Kral 27068, 3rd division). 37. *F. miliacea* (Kral 19320, end of 2nd division). 38. *F. miliacea* (Kral 19380, 3rd division). 39. *F. schoenoides* (Kral 23142, end of 2nd division and 3rd division). 40. *F. schoenoides* (Kral 23142, end of 3rd division). 41. *F. schoenoides* (Kral 18616, 3rd division). 42. *F. tomentosa* (Kral 20692, prophase 1). 43. *F. perpusilla* (from Godfrey collection, Seminole Co., Georgia). 44. *F. vahlü* (Kral 15910, 3 nuclei from end of 2nd division). 45. *F. vahlü* (Kral 23228, prophase 1). 46. *F. vahlü* (Kral 29018, 3rd division). 47. *F. decipiens* (Kral 27852, prophase 1). 48. *F. decipiens* (Kral 27846, 3rd division). 49. *F. decipiens* (Kral 27846, late 3rd division). 50. *F. dichotoma* (Kral 27785, prophase 1). 51. *F. dichotoma* (Kral 18594, 2nd division). 52. *F. dichotoma* (Kral 27832, 3rd division). 53. *F. dichotoma* (Kral 27854, 3rd division). 54. *F. dichotoma* (Kral 20801, prophase 1). 55. *F. spadicea* (Kral 27805, 3rd division). 56. *F. spadicea* (Kral 24993, 3rd division). 57. *F. thermalis* (Kral 25771, 3rd division). 58. *F. thermalis* (Kral 21591, prophase 1). 59. *F. thermalis* (Kral 21591, metaphase 1). 60. *F. thermalis* (Kral 21784, metaphase 2). 61. *F. thermalis* (Kral 21591, 3rd division). 62. *F. castanea* (Kral 22470, prophase 1). 63. *F. castanea* (Kral 22415, metaphase 2). 64. *F. castanea* (Kral 22559, prophase 1, and 3rd division). 65. *F. pallidula* (Kral 27501, prophase 1). 66. *F. pallidula* (Kral 27724, prophase 1). 67. *F. pallidula* (Kral 27495, 3rd division). 68. *F. argillicola* (Kral 27447, metaphase 2). 69. *F. argillicola* (Kral



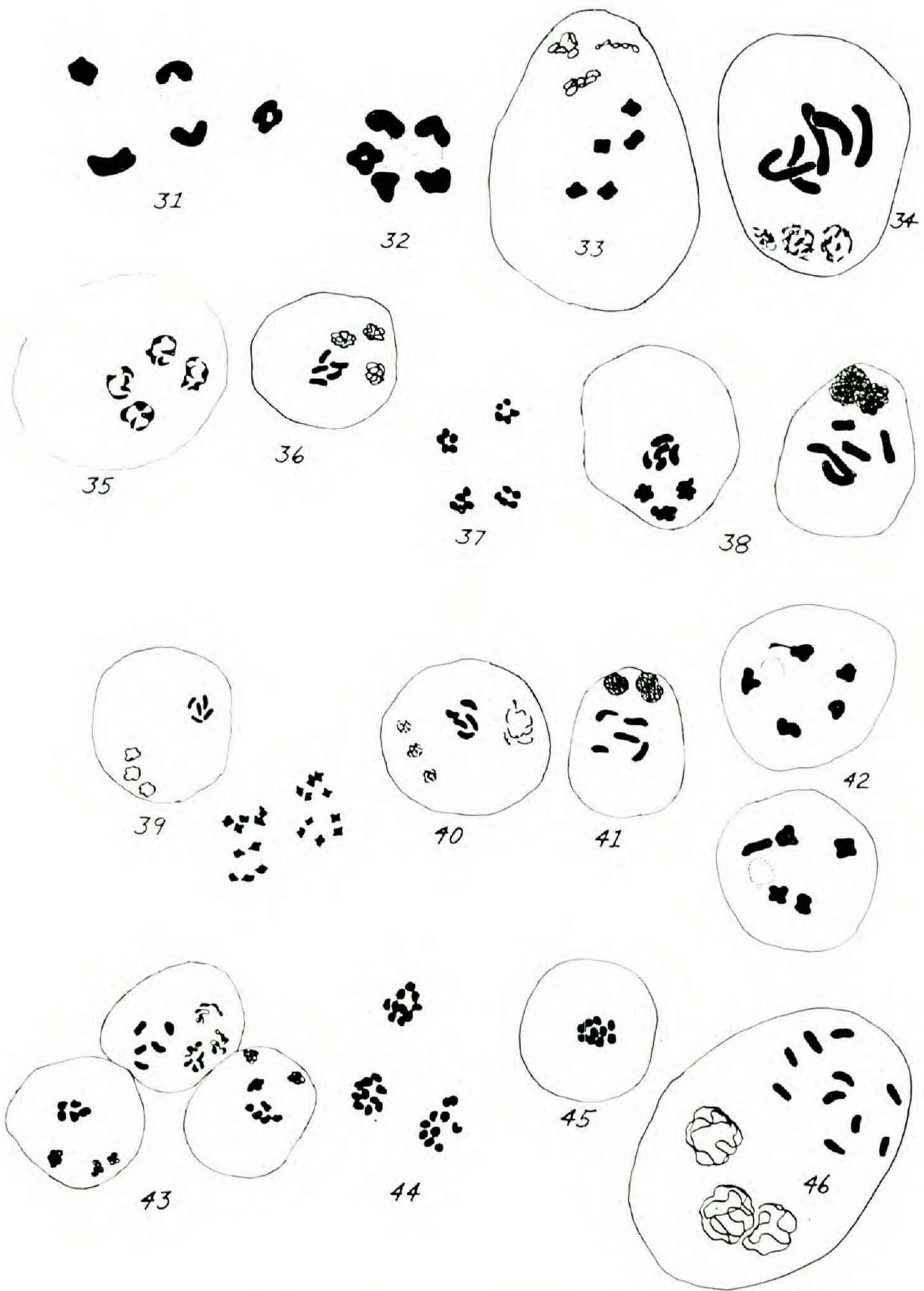
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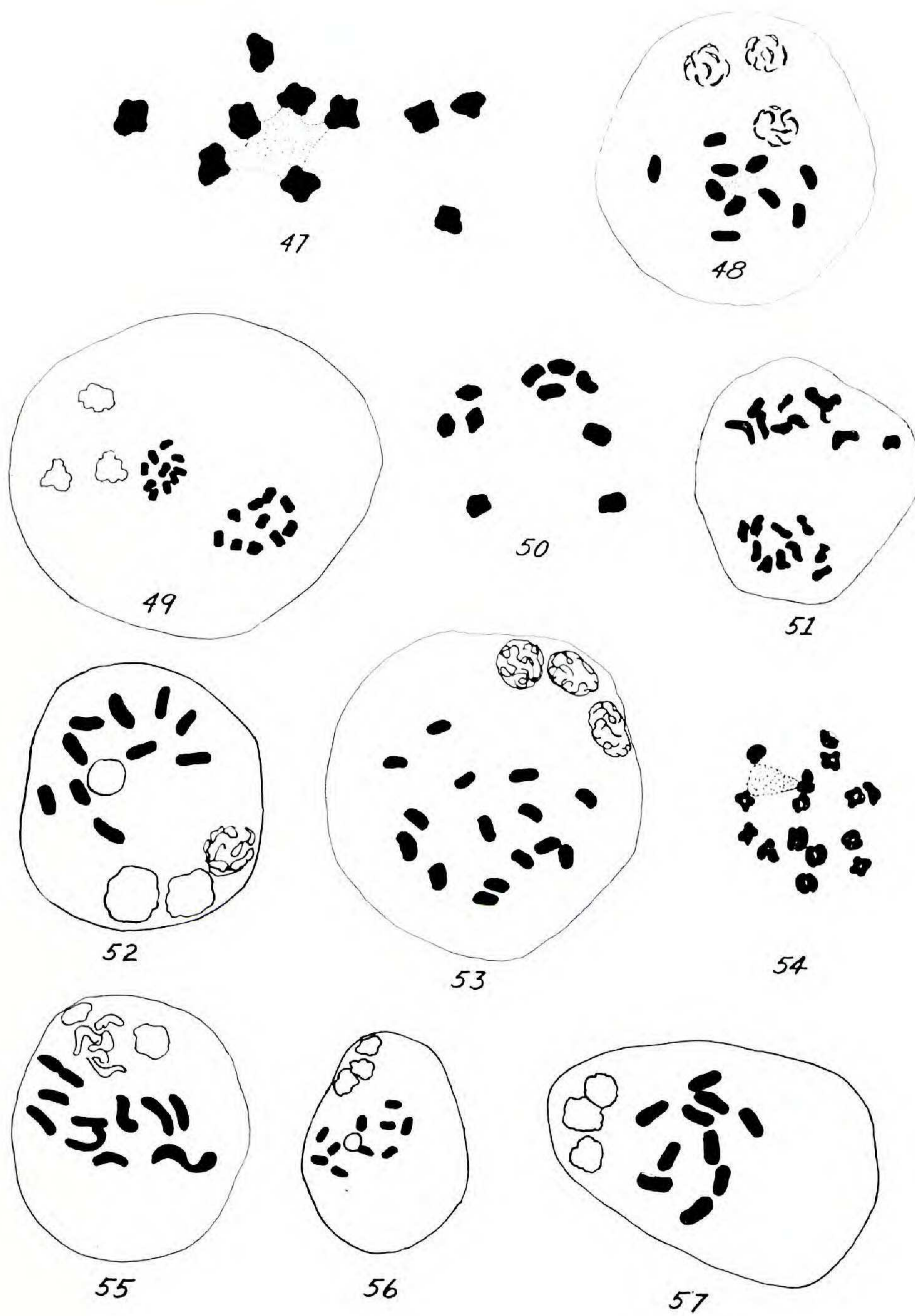
20490, prophase 1). 83. *F. caroliniana* (Kral 22909, 3rd division). 84. *F. caroliniana* (Kral 27809, 3rd division). 85. *F. caroliniana* (Kral 27806, 3rd division). 86. *F. caroliniana* (Kral 22957, late prophase 1). 87. *F. caroliniana* (Kral 23214, 3rd division). 88. *F. caroliniana* (Kral 22469, 3rd division). 89. *F. caroliniana* (Kral 22868, 3rd division). 90. *F. spathacea* (from specimens grown



from seed collected in Martin Co., Florida in the winter of 1963; 3rd division). 91. *F. tomentosa* (Kral 18937, prophase 1). 92. *F. tomentosa* (Kral 27853, 3rd division).



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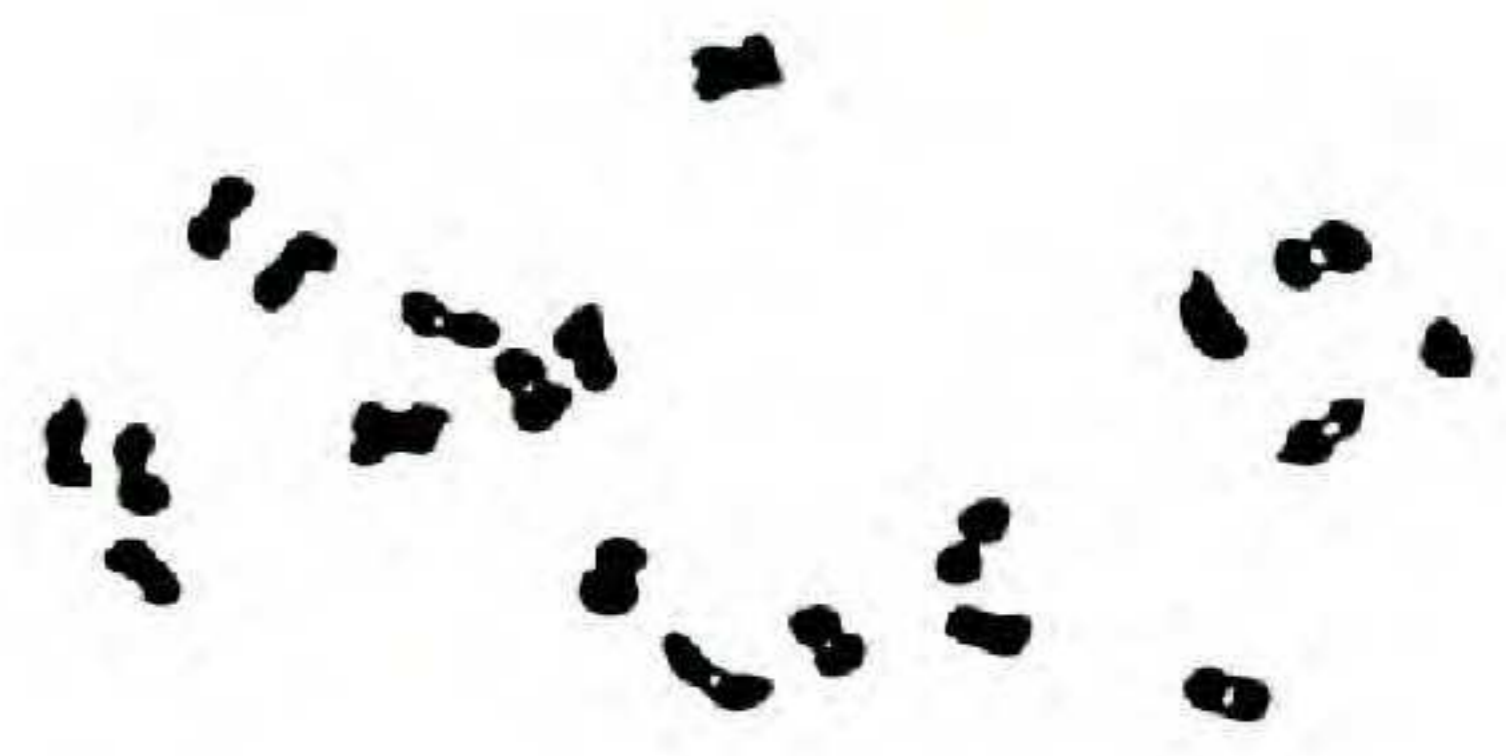
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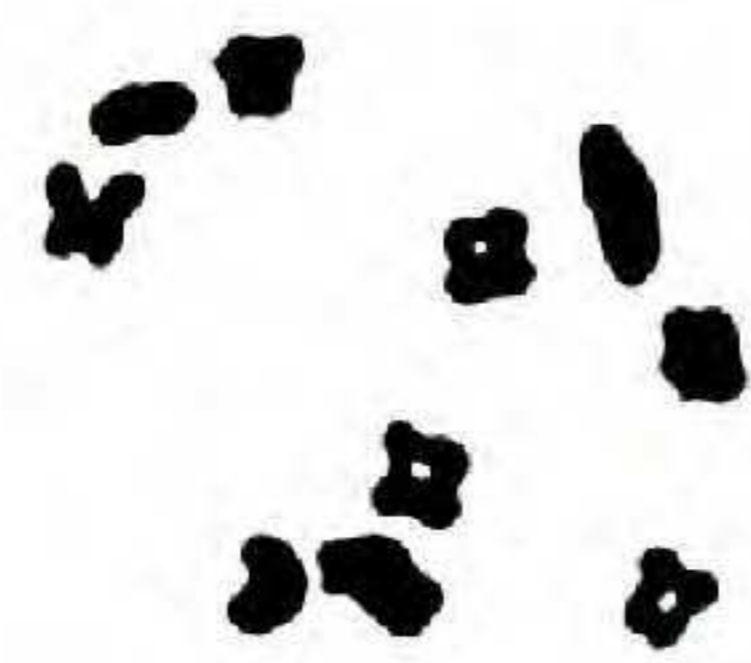
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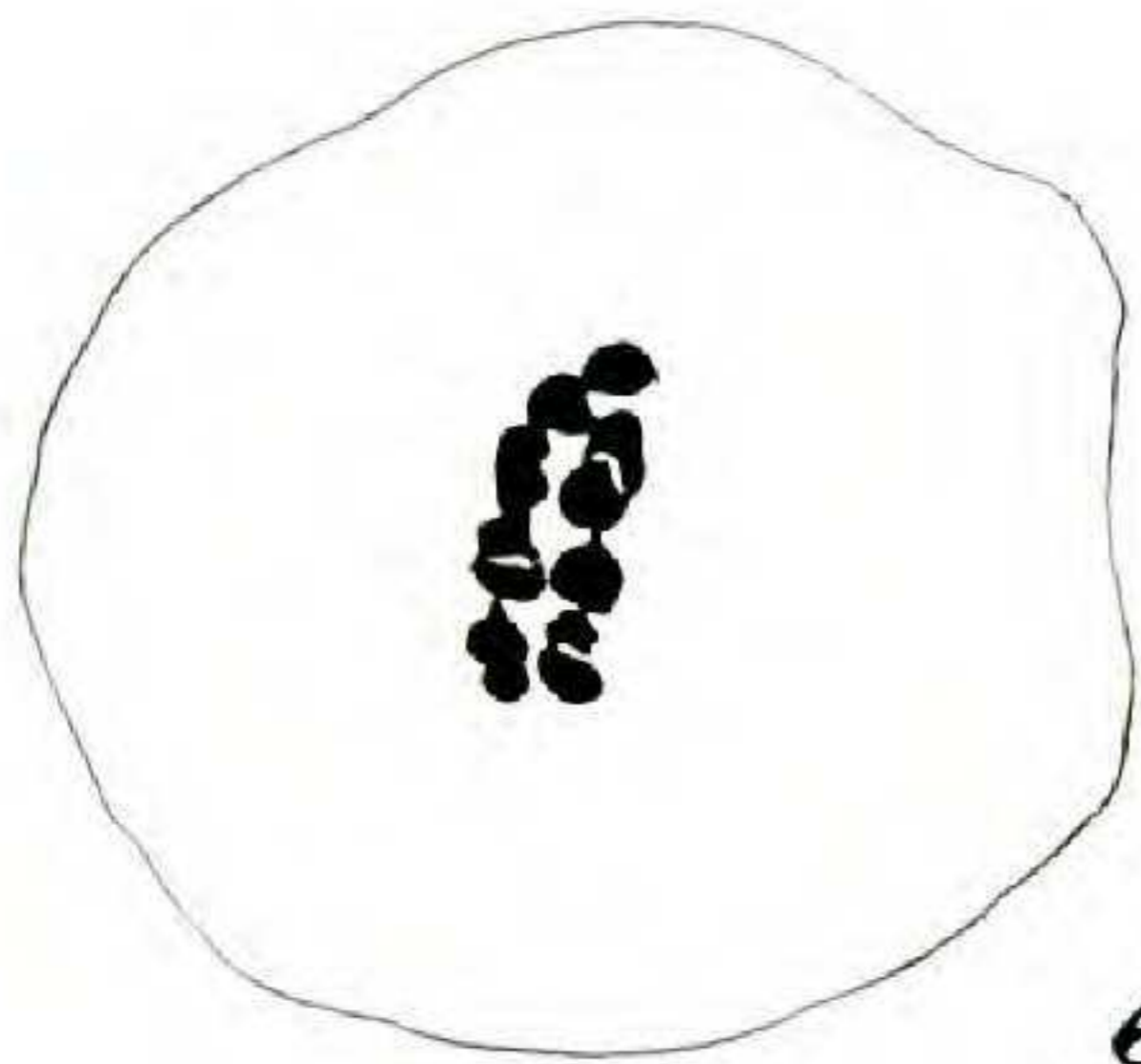
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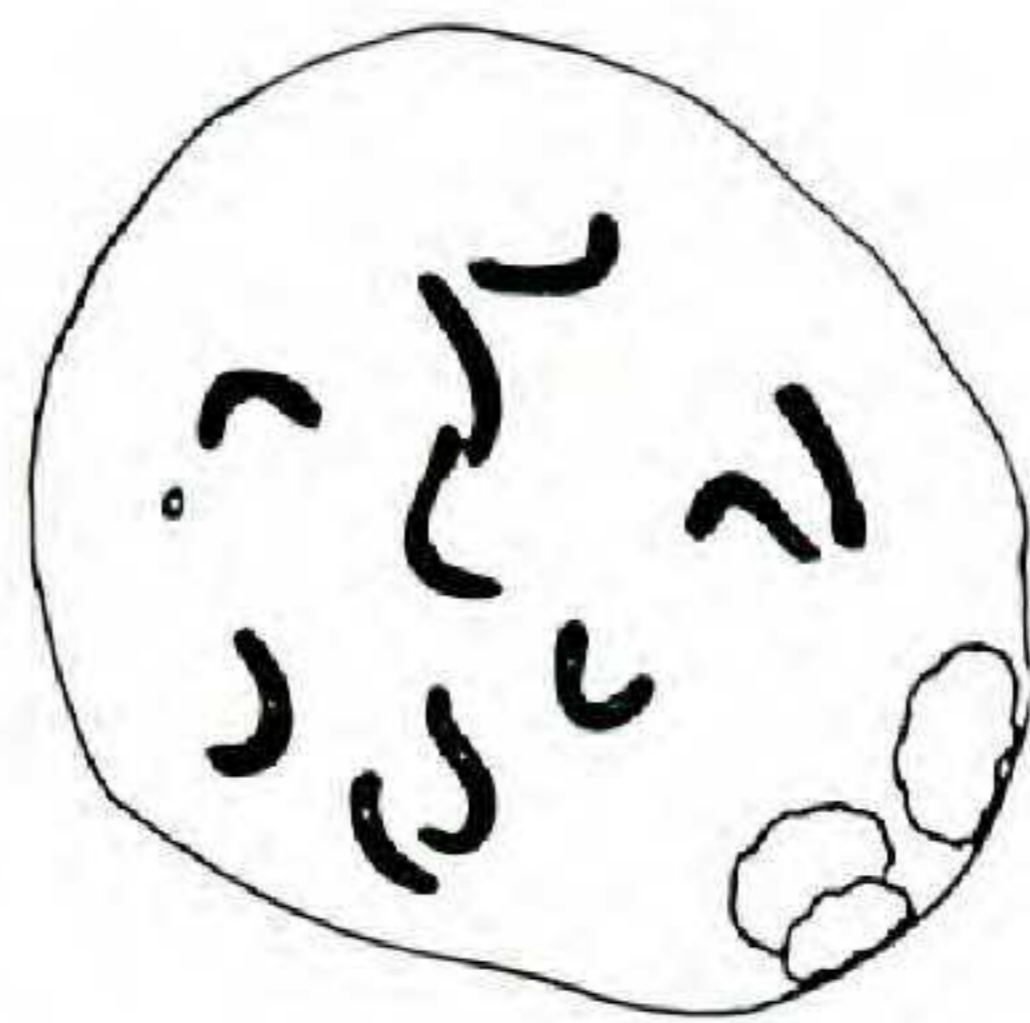
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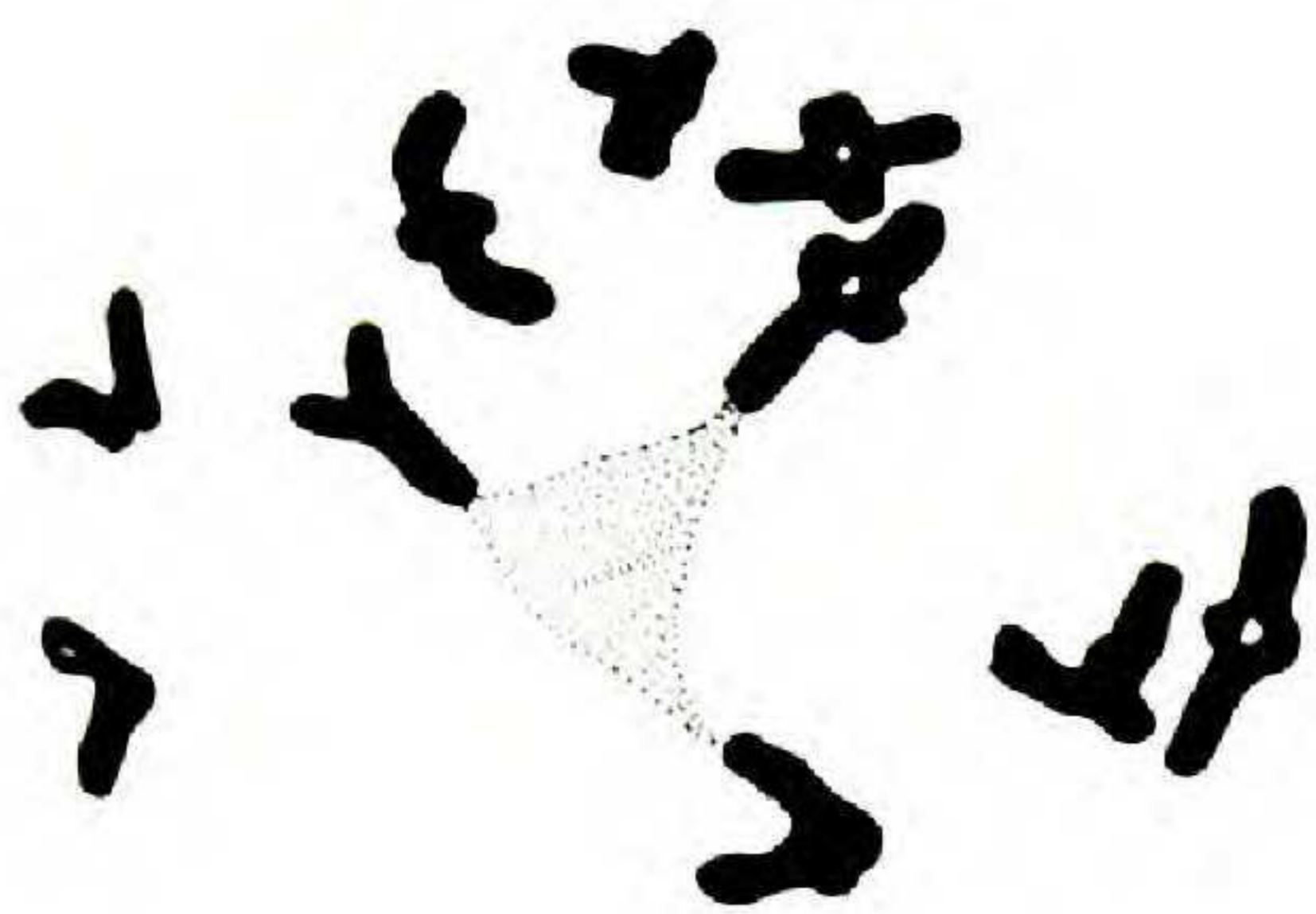
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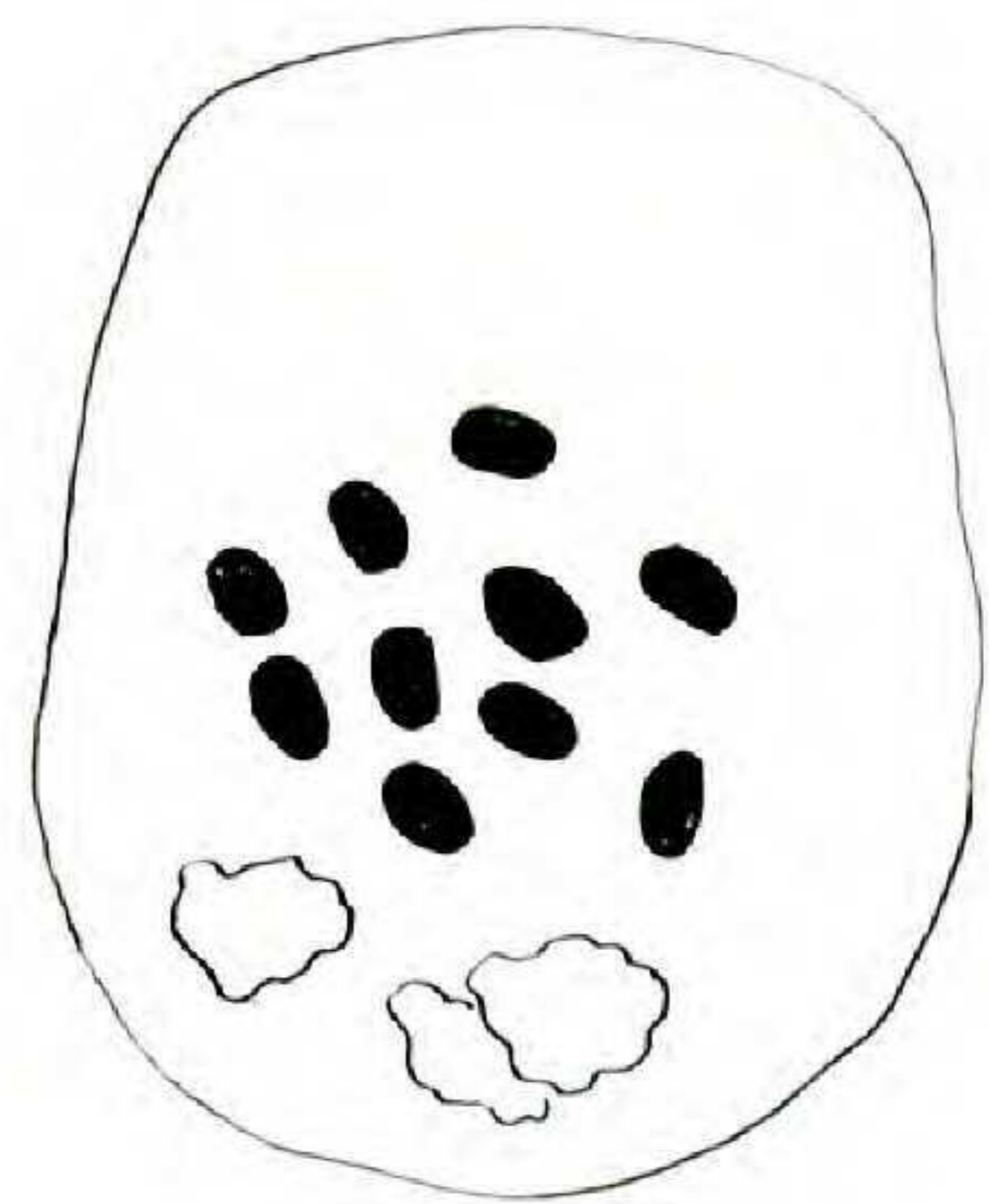
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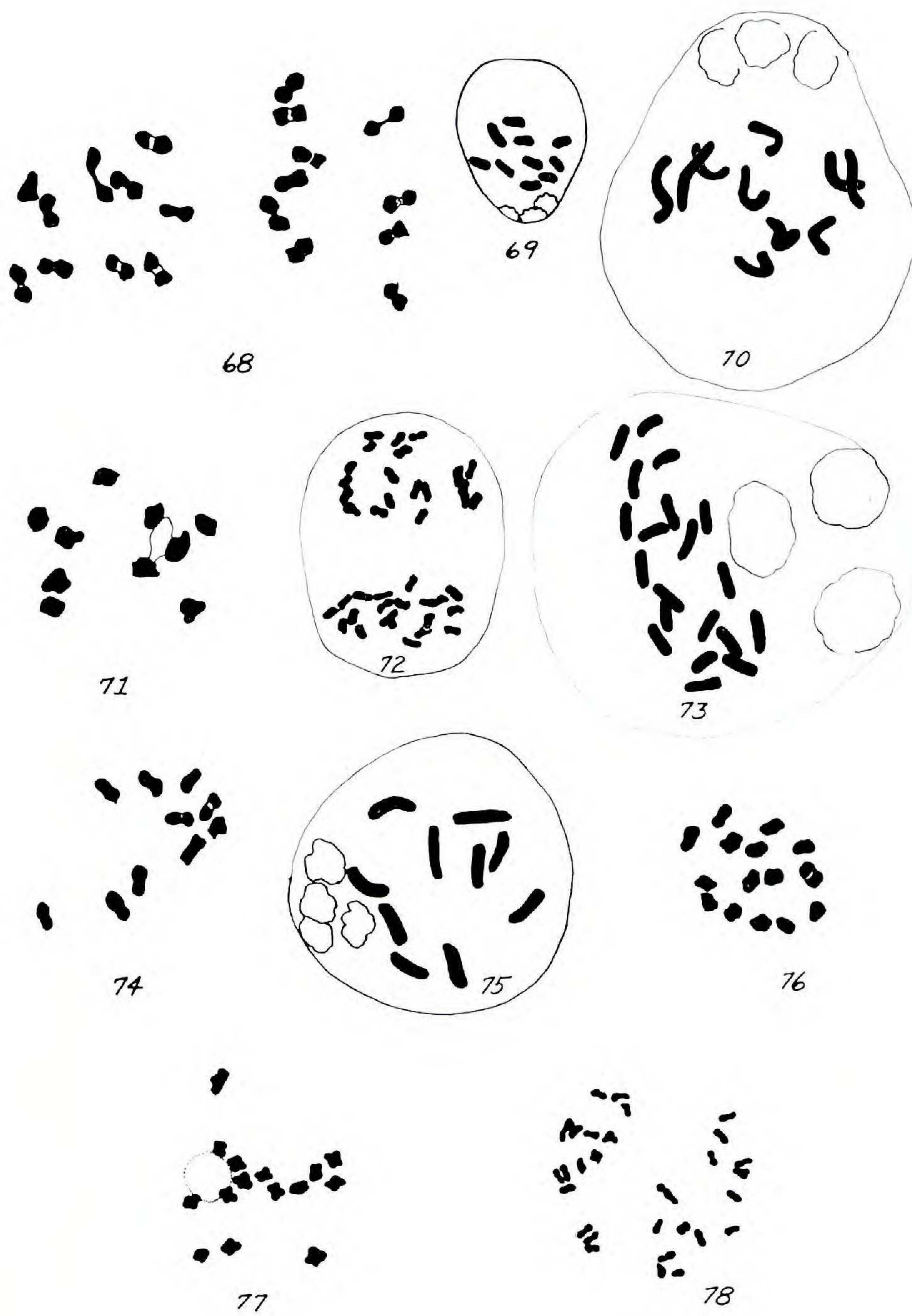


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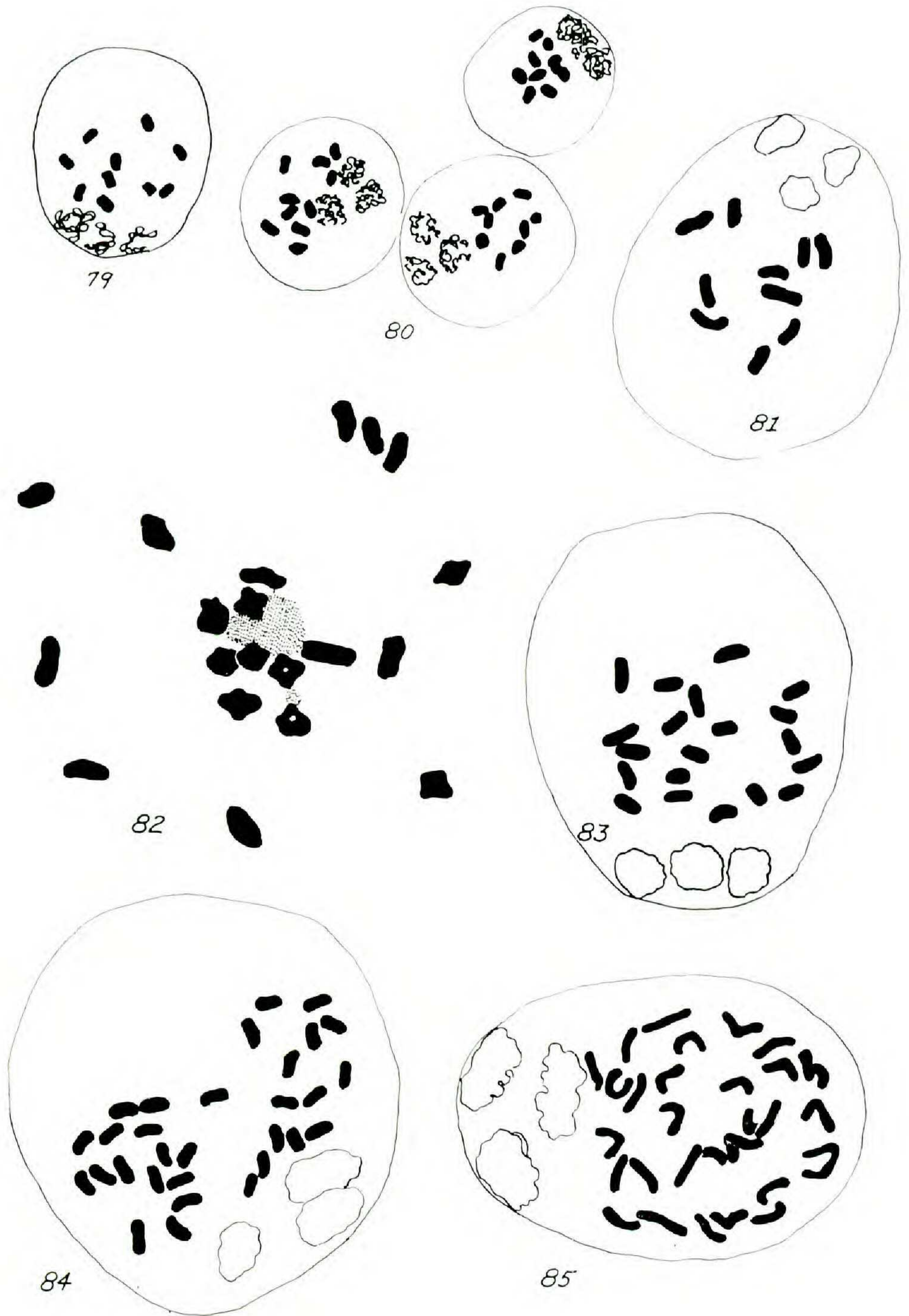


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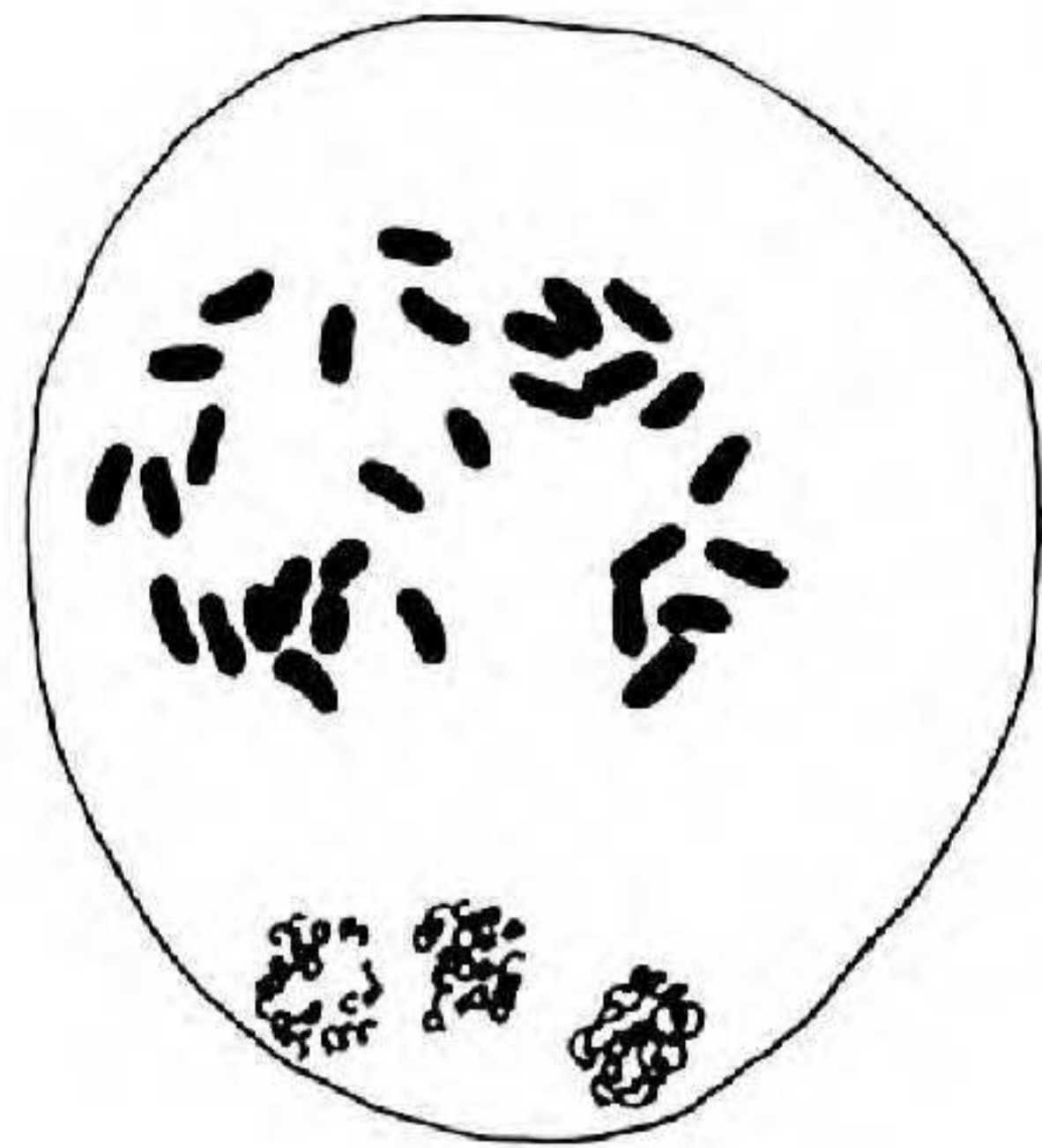
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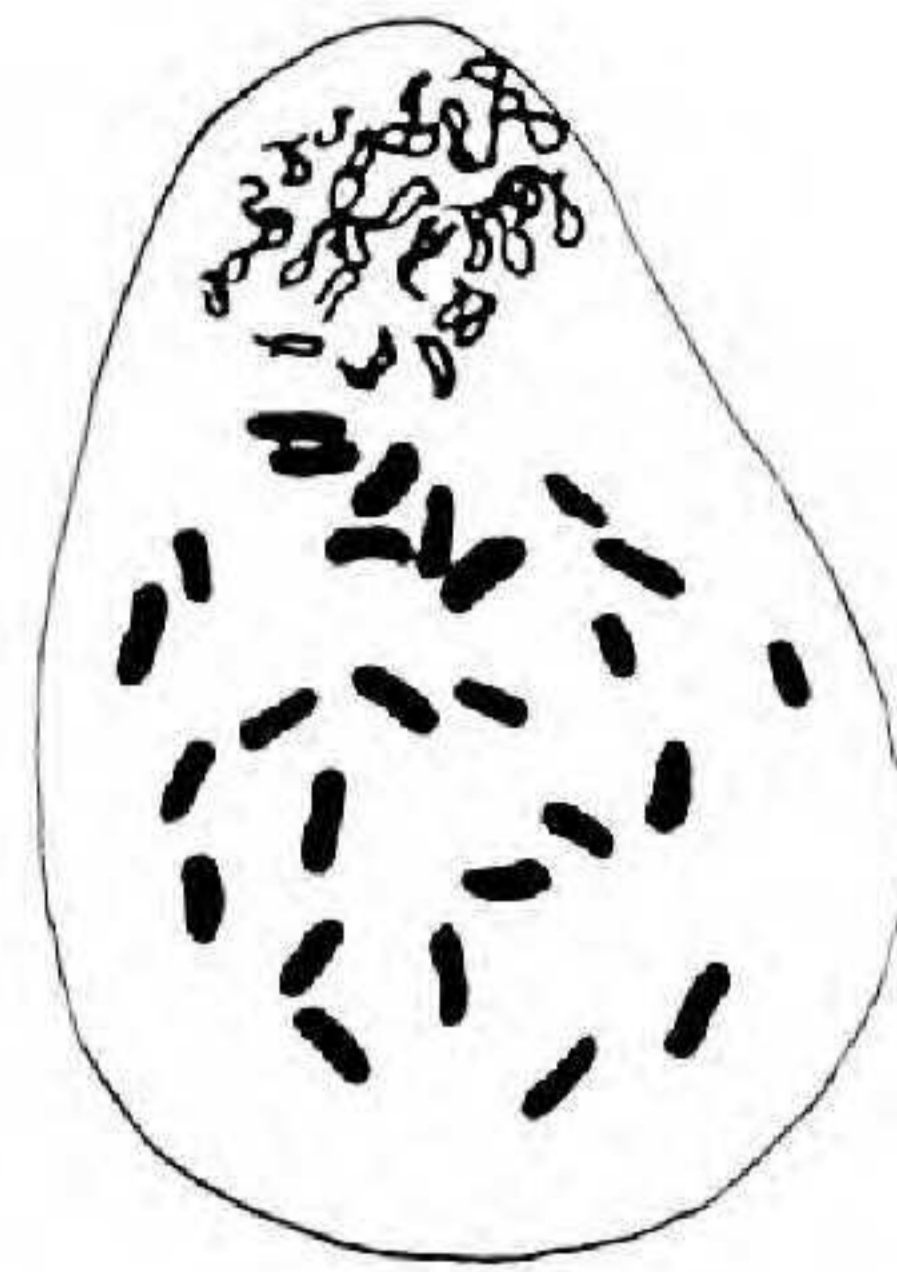
(Captions on pages 198-201.)



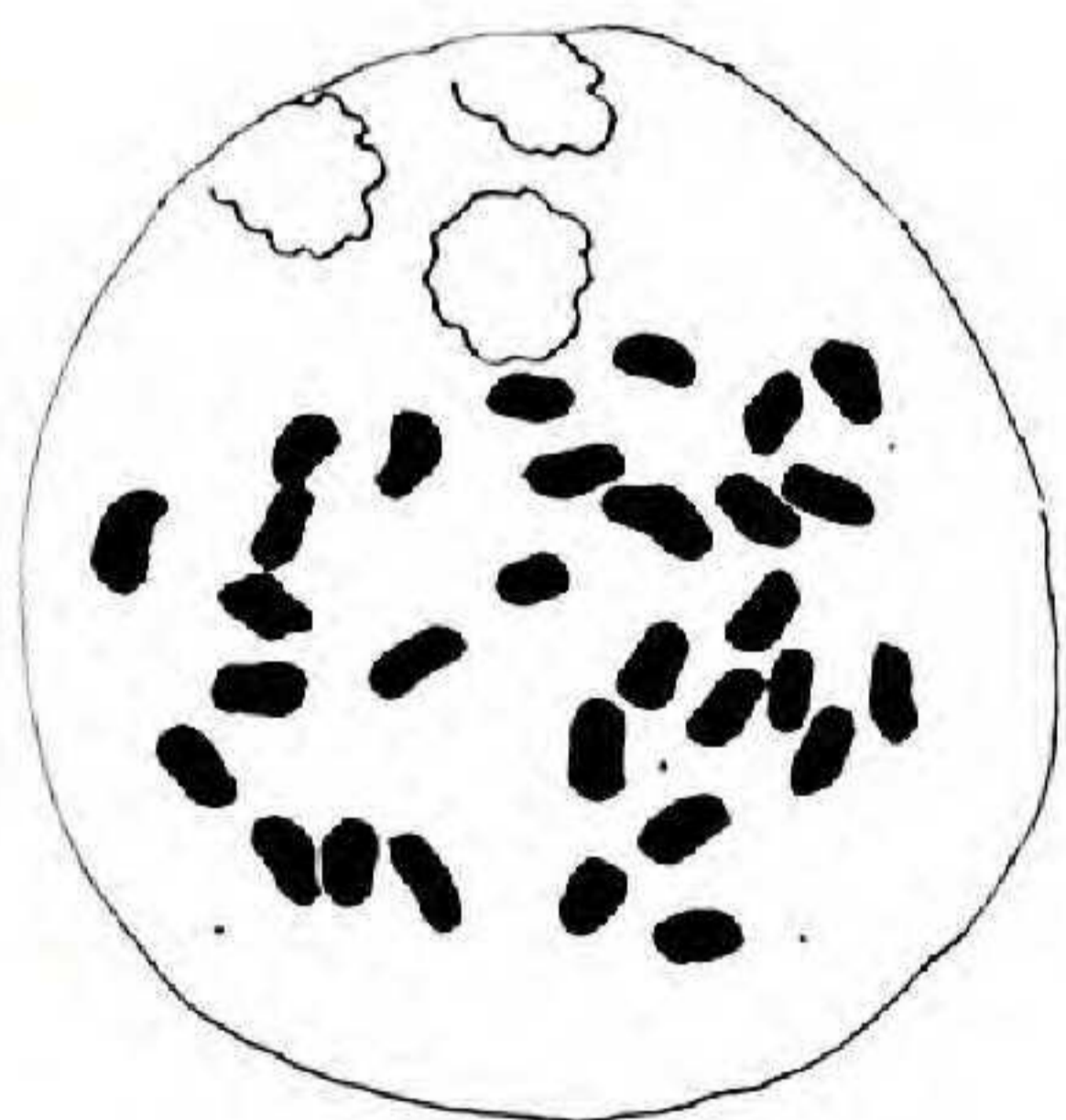
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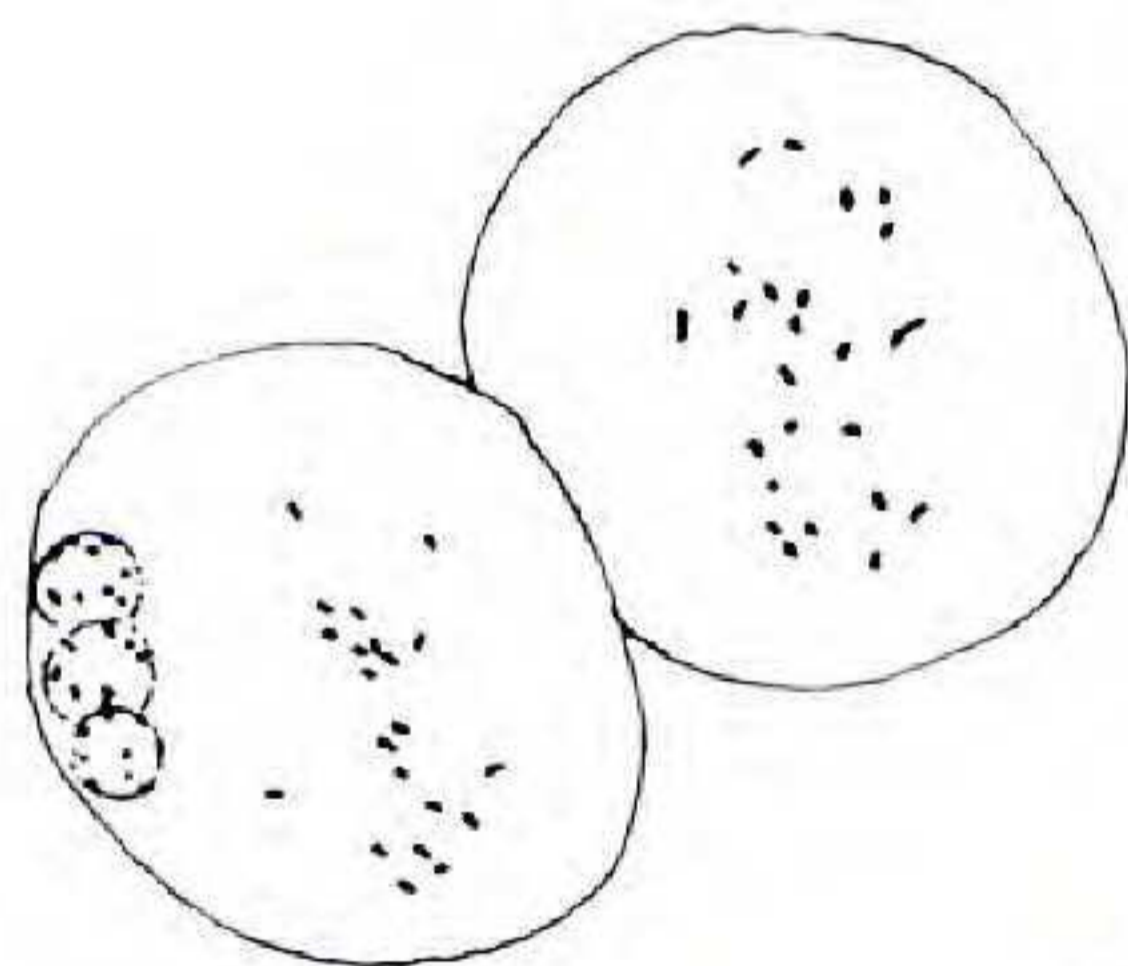
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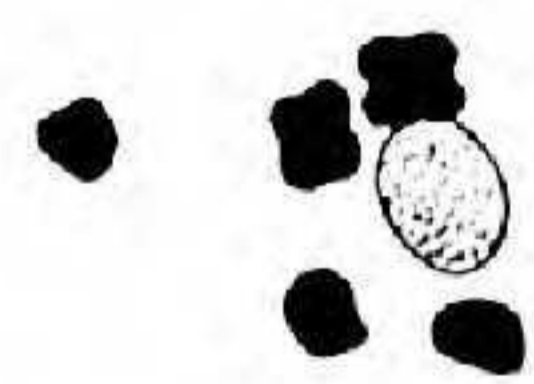
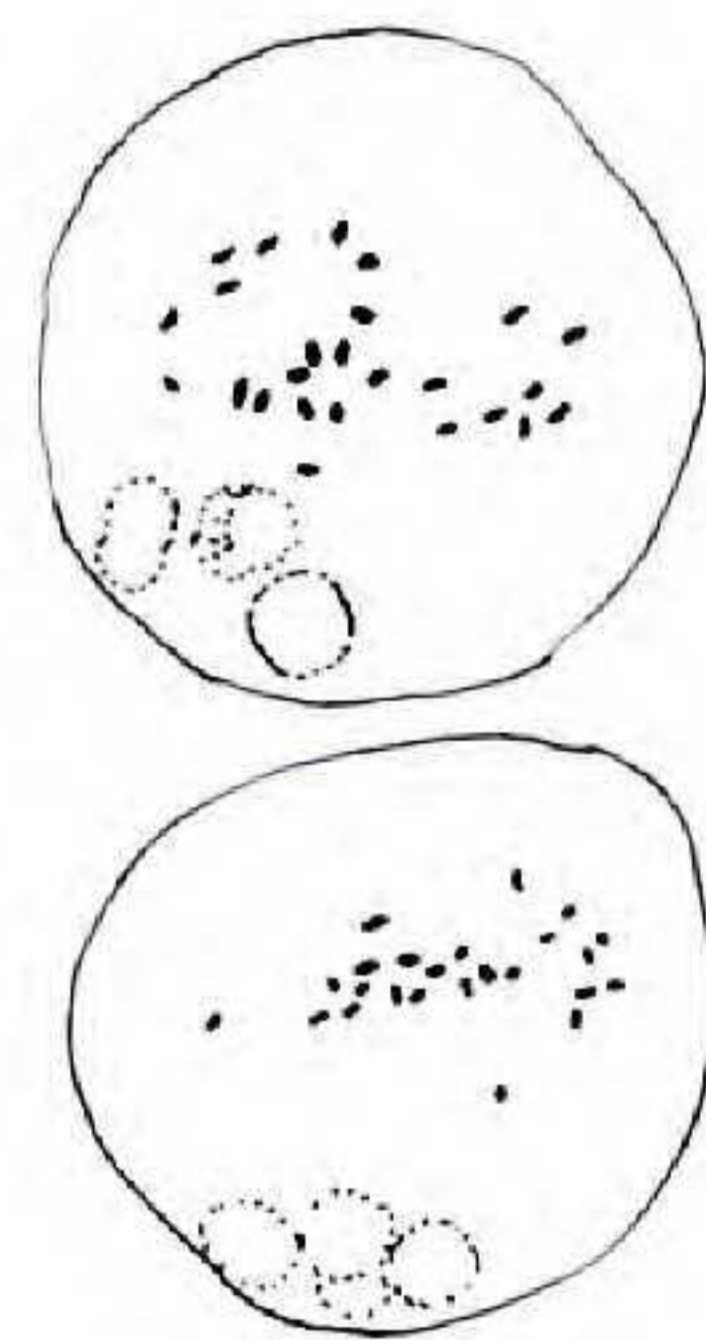
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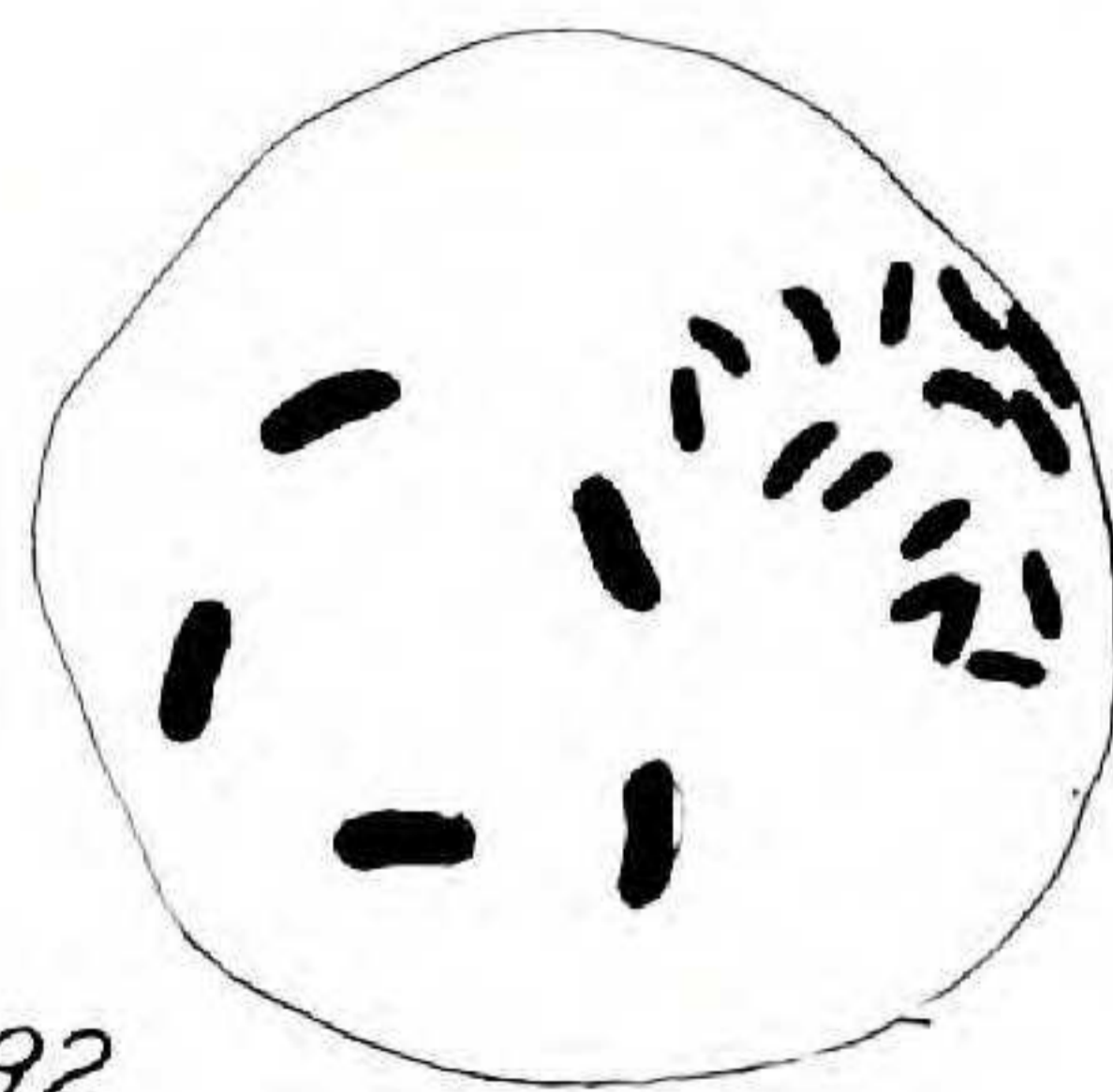
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(Captions on pages 198-201.)

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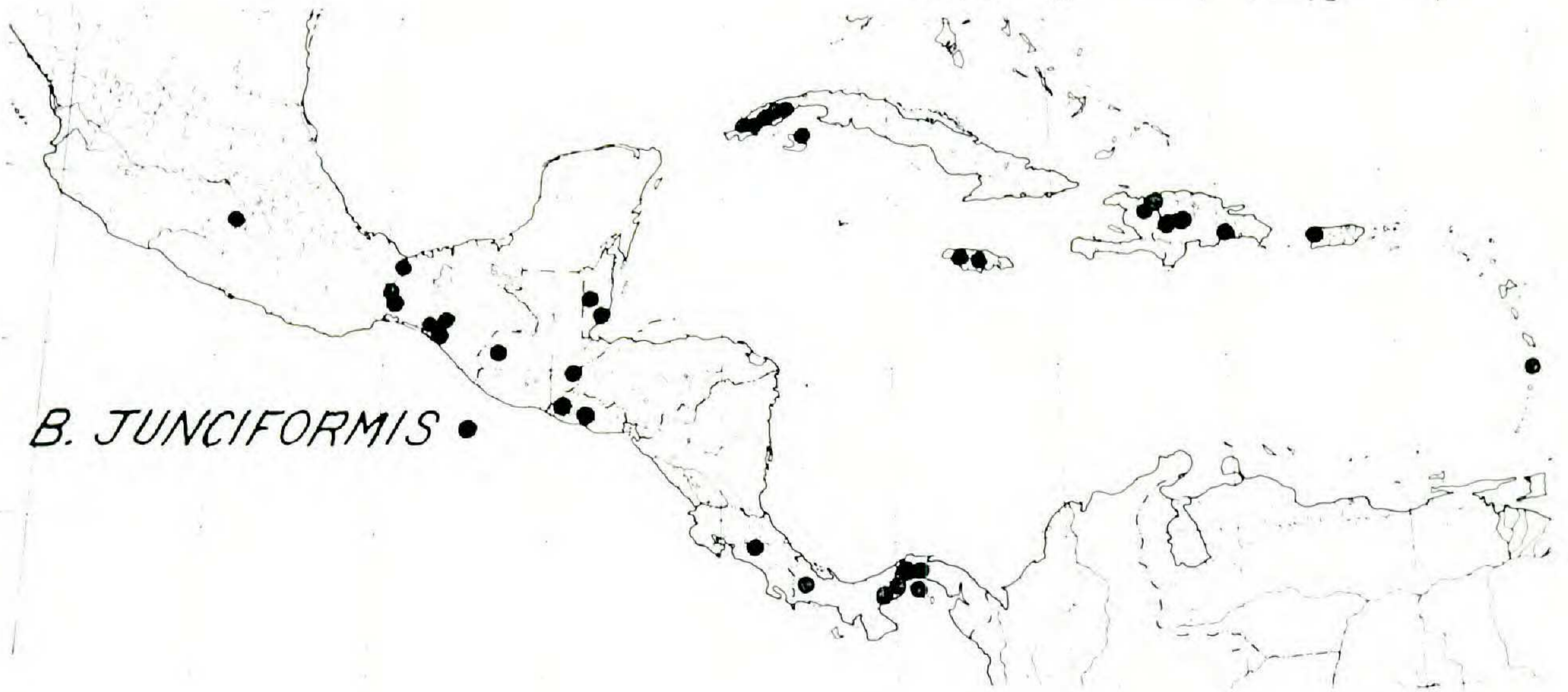
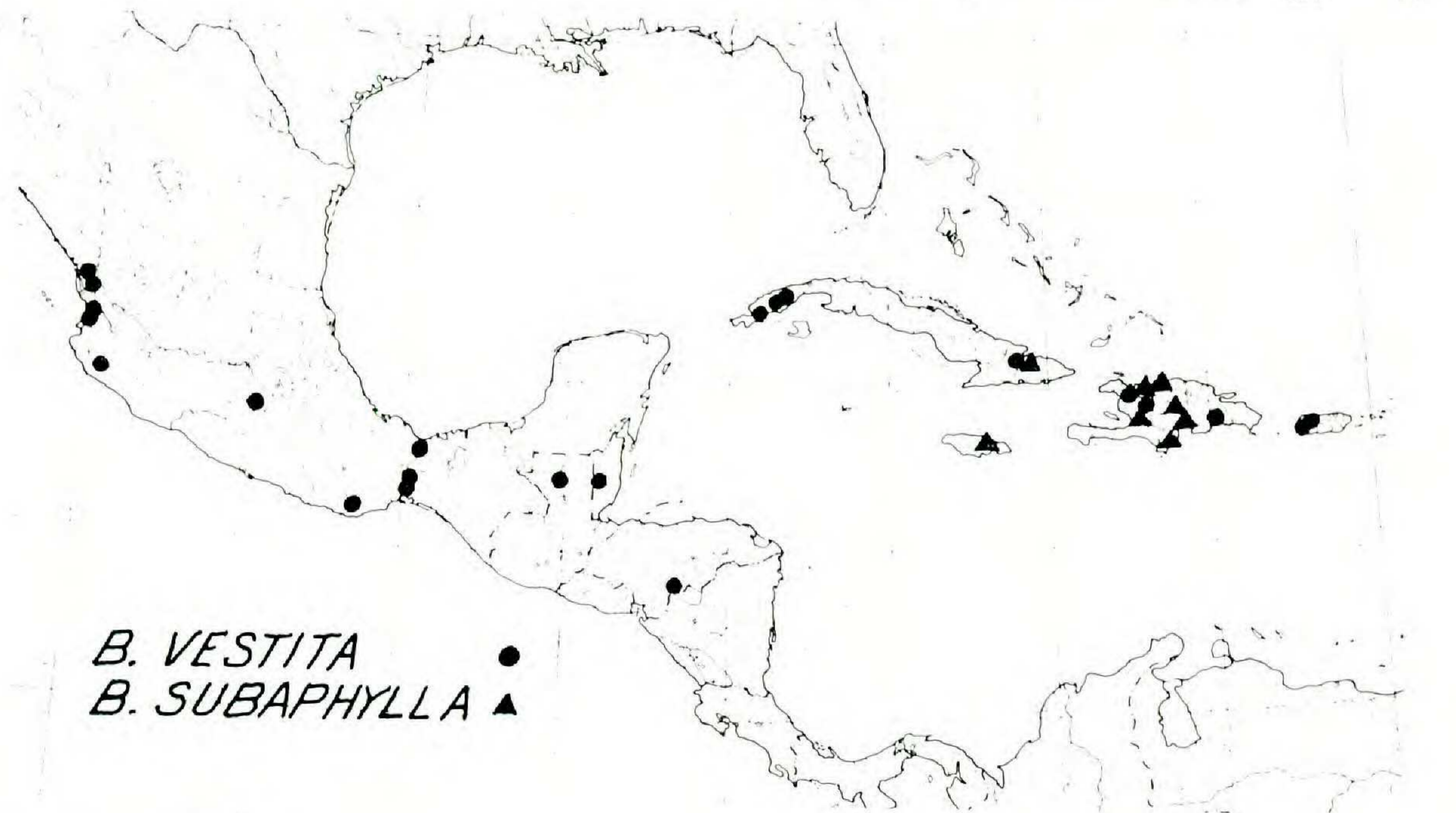
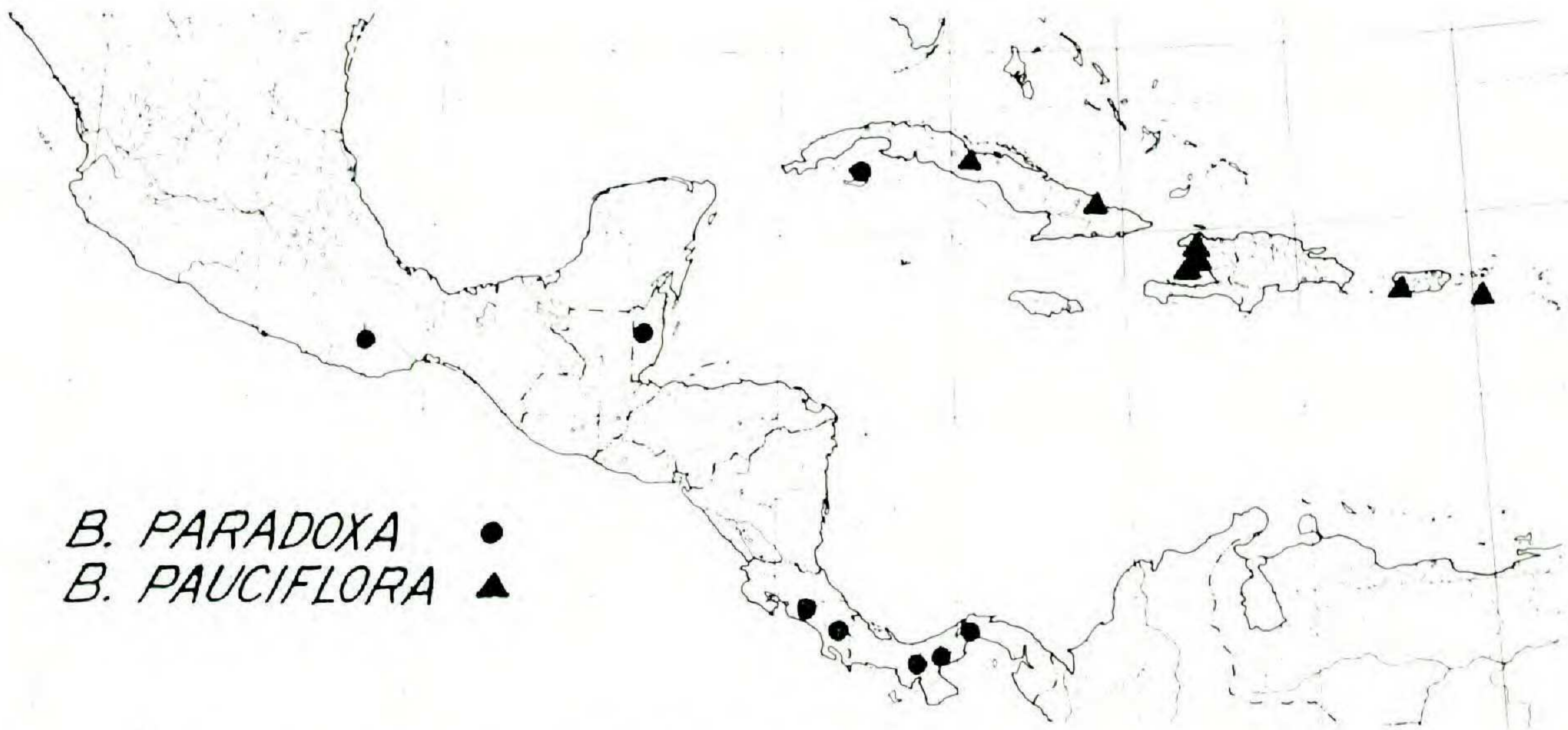
Distributions of Mexican and Caribbean species are shown on the Goode's Series of Base Maps copyright by the University of Chicago.

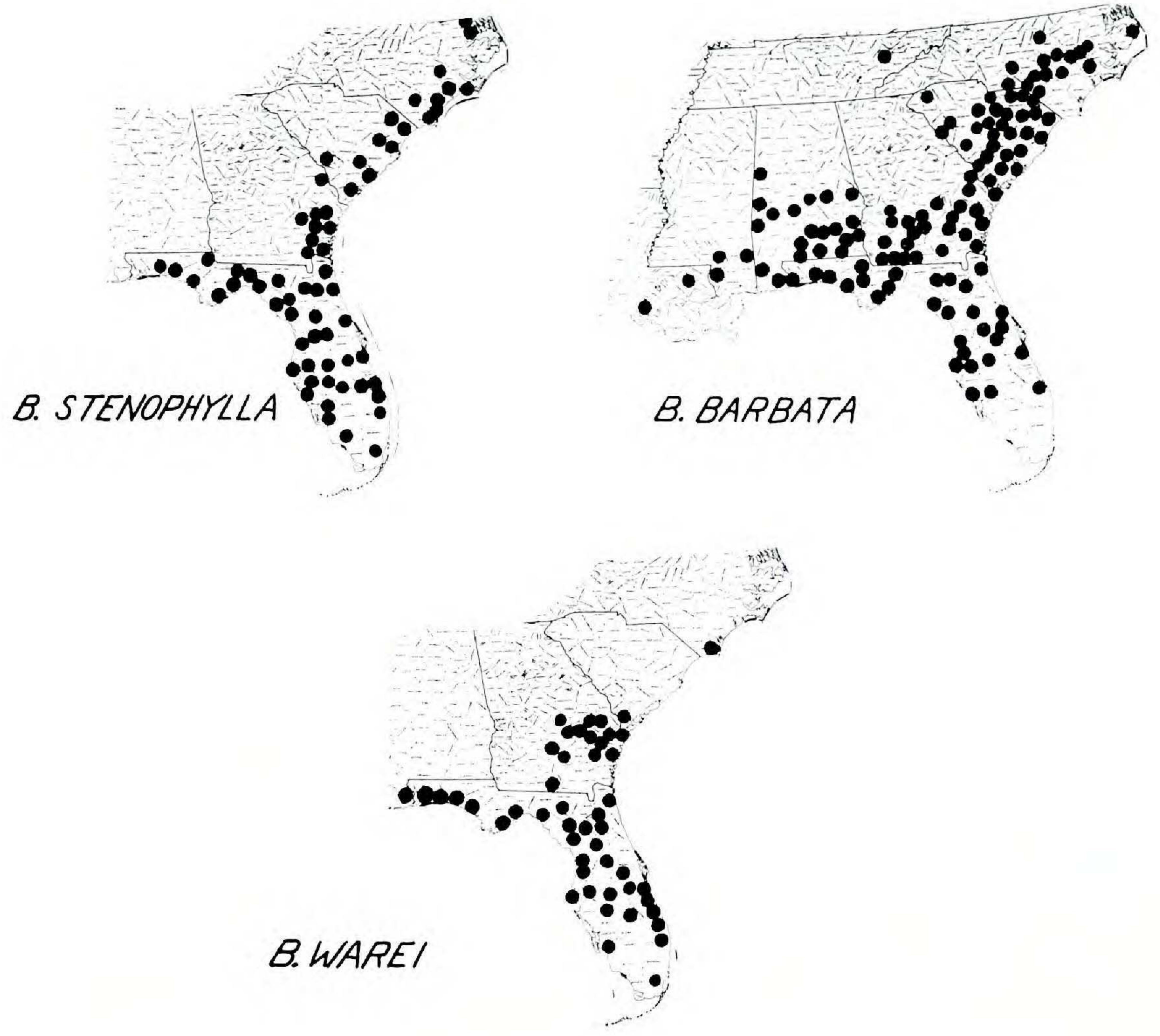
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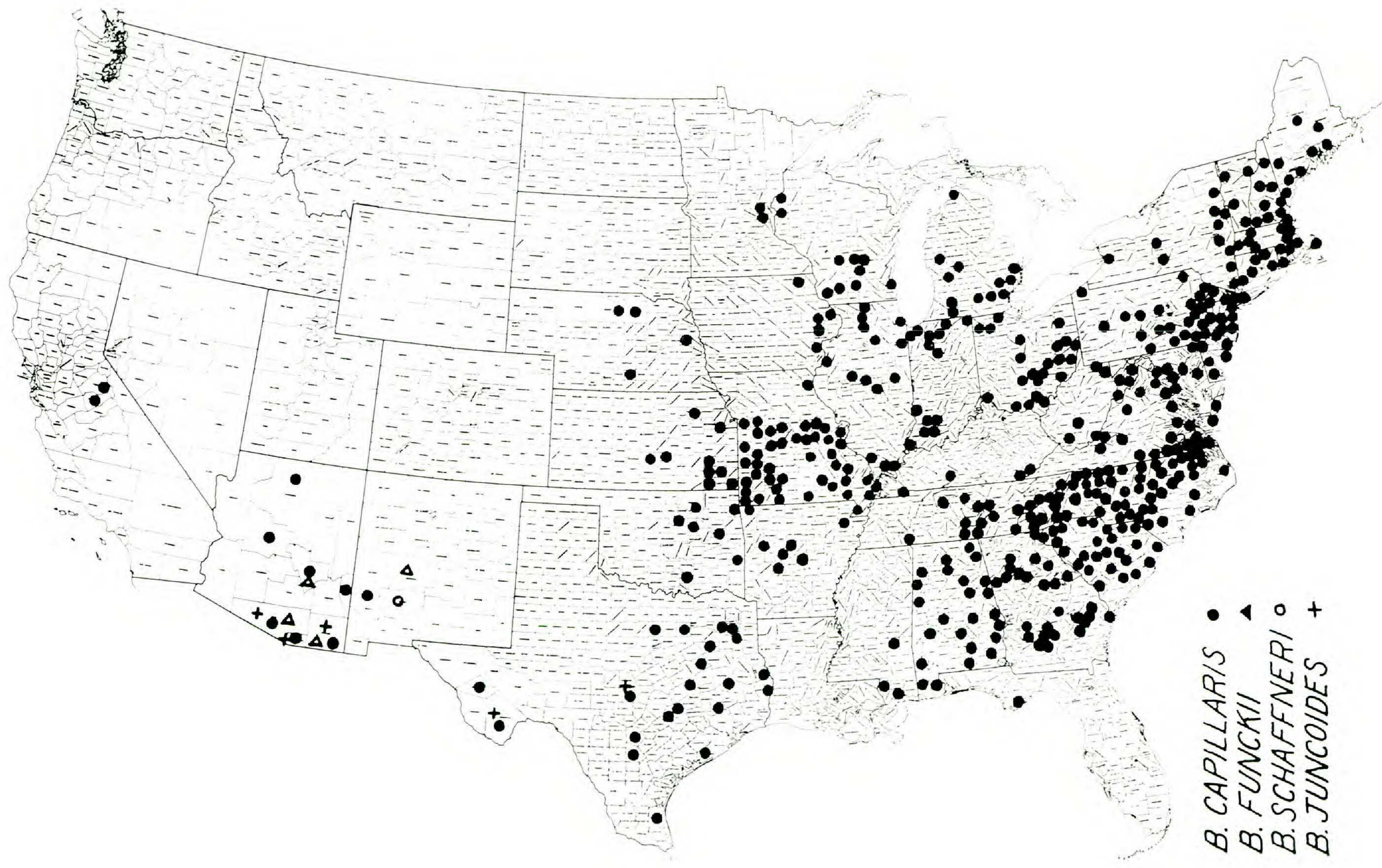
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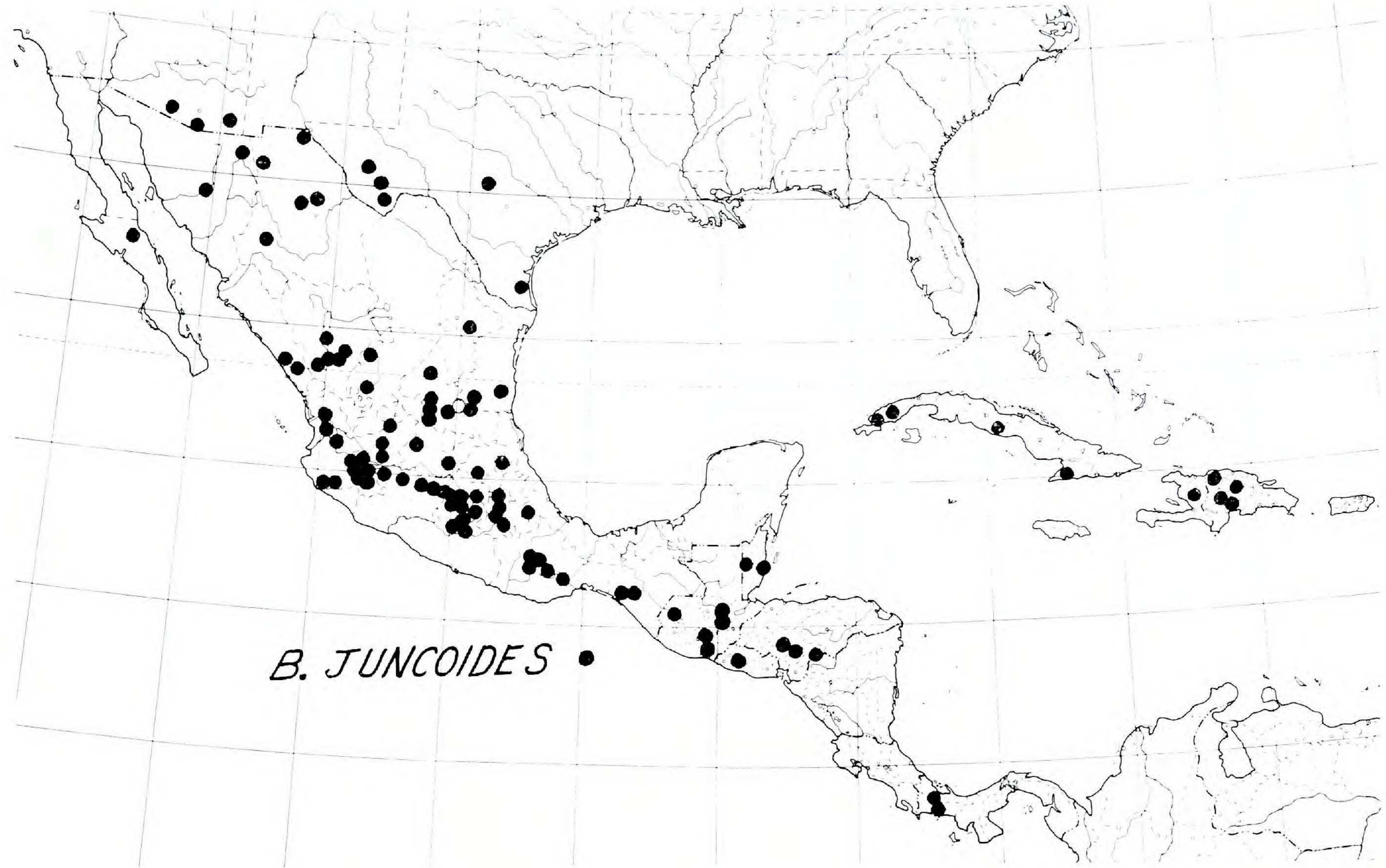
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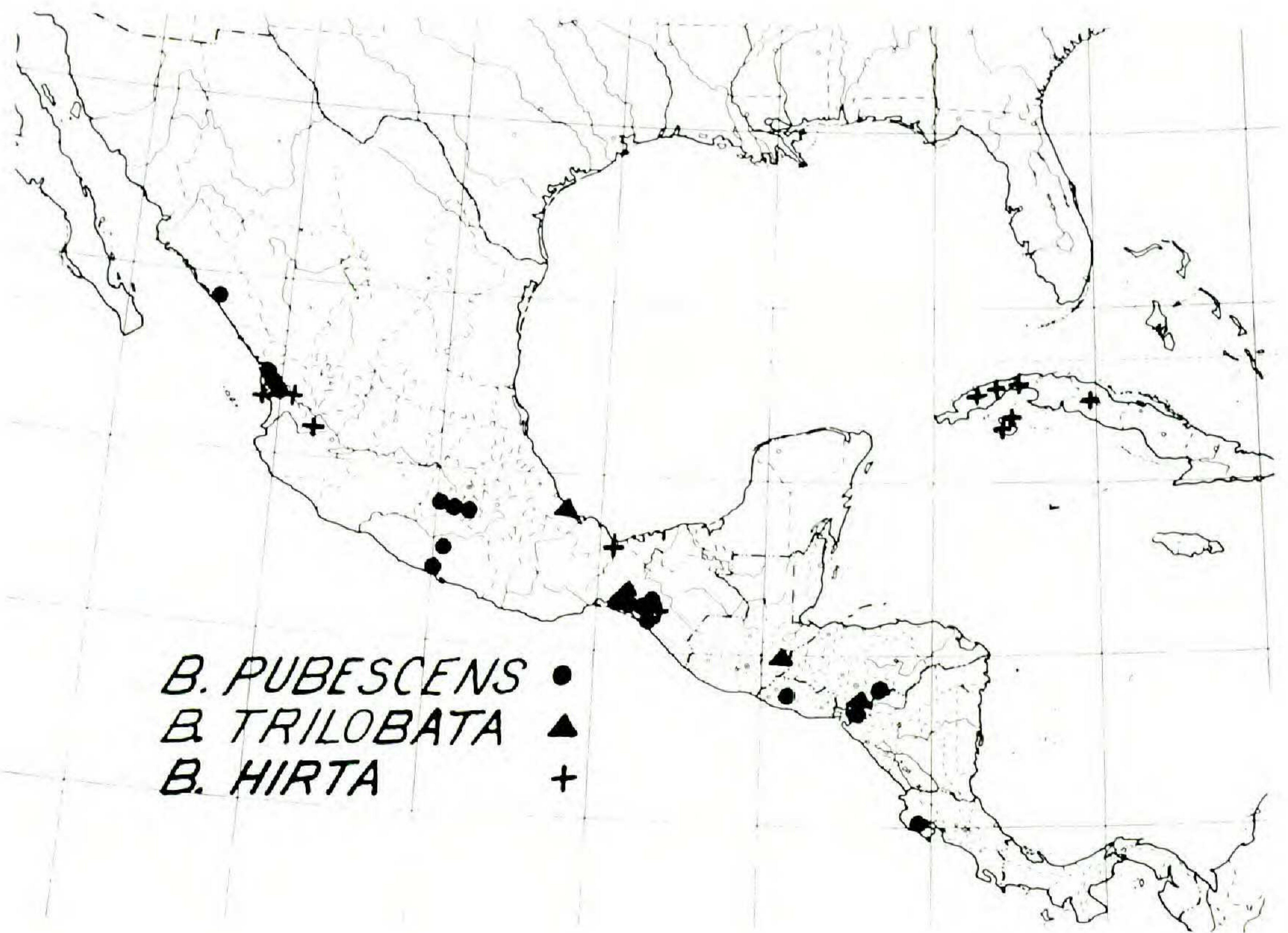


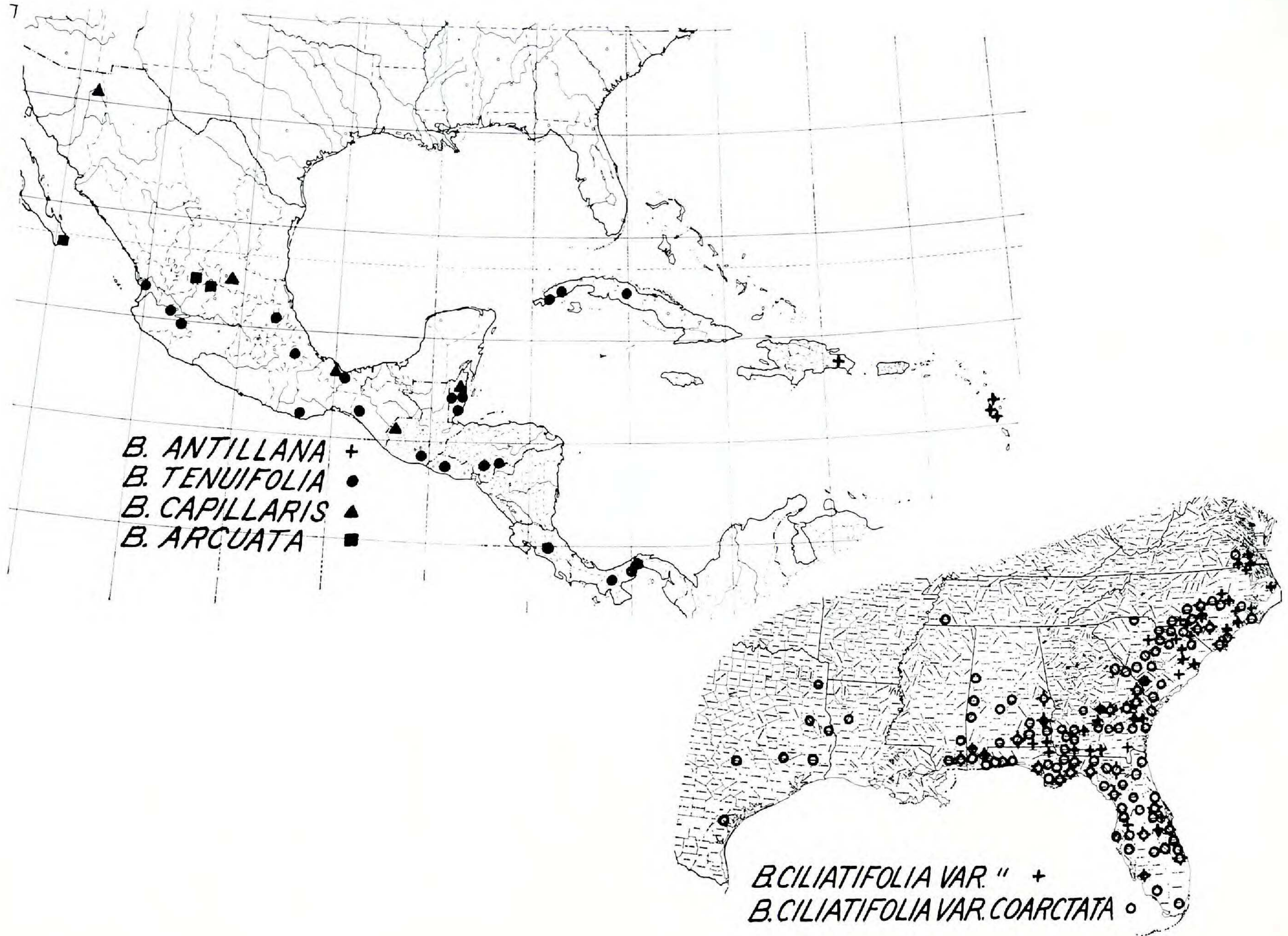


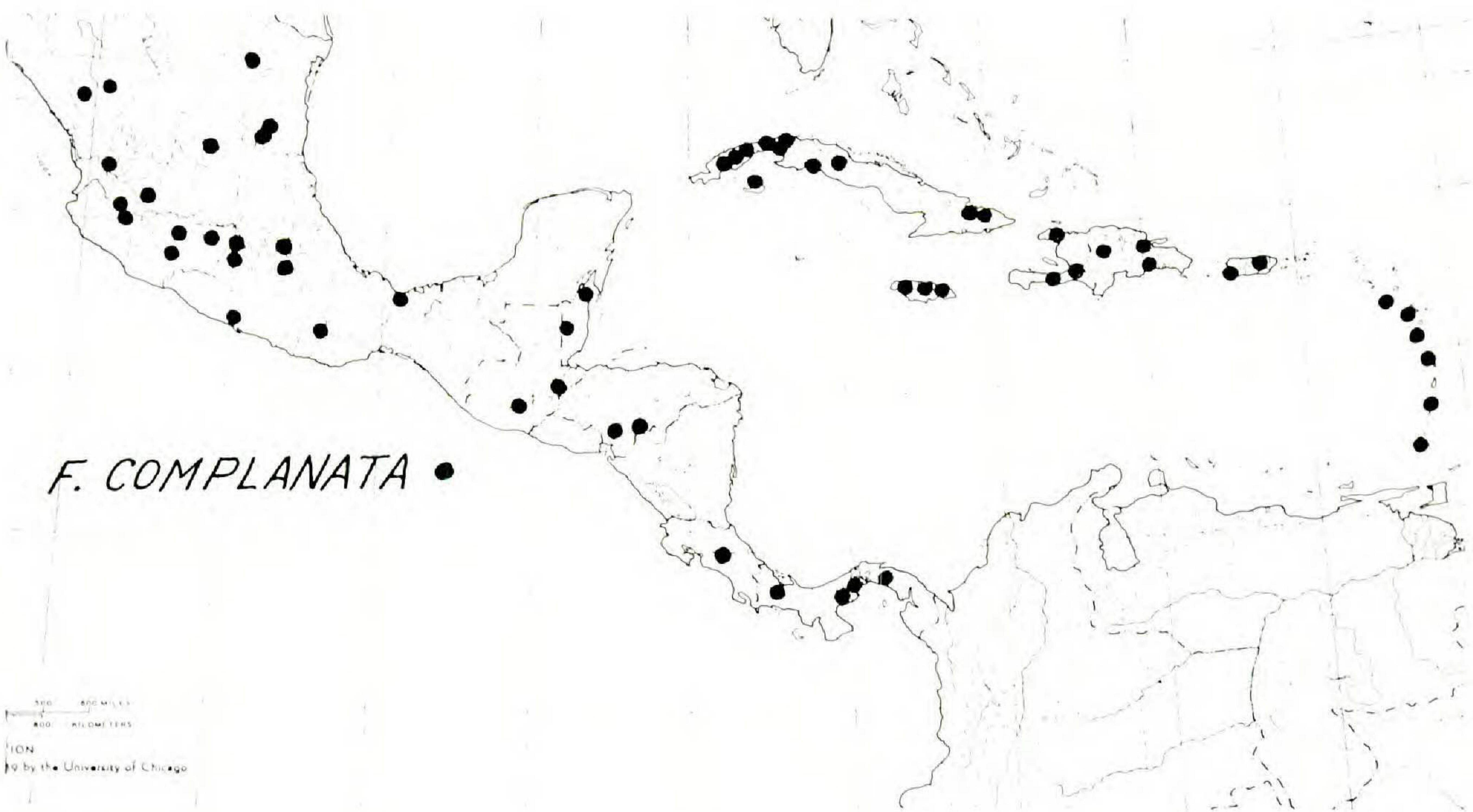
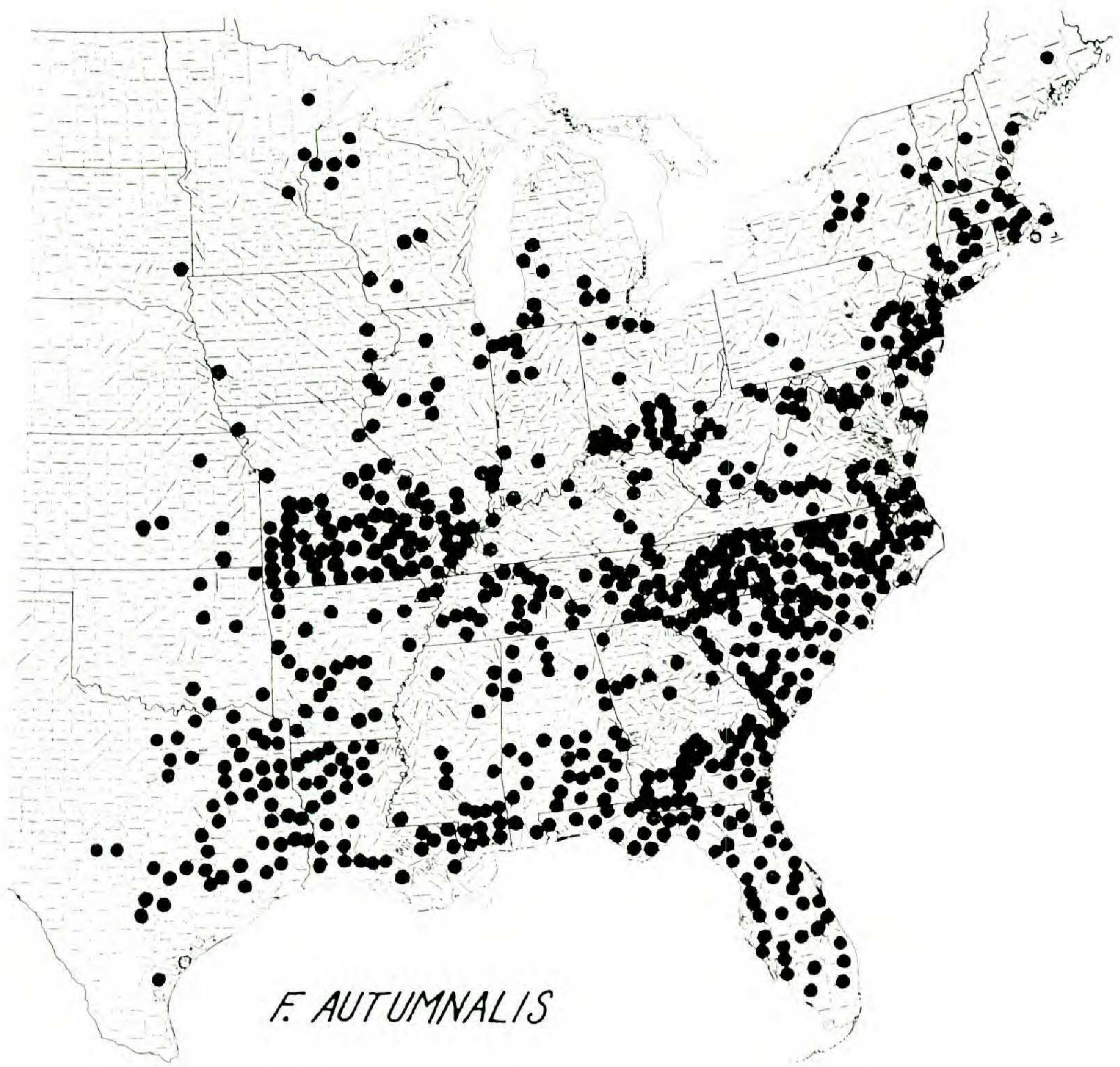




B. JUNCOIDES •

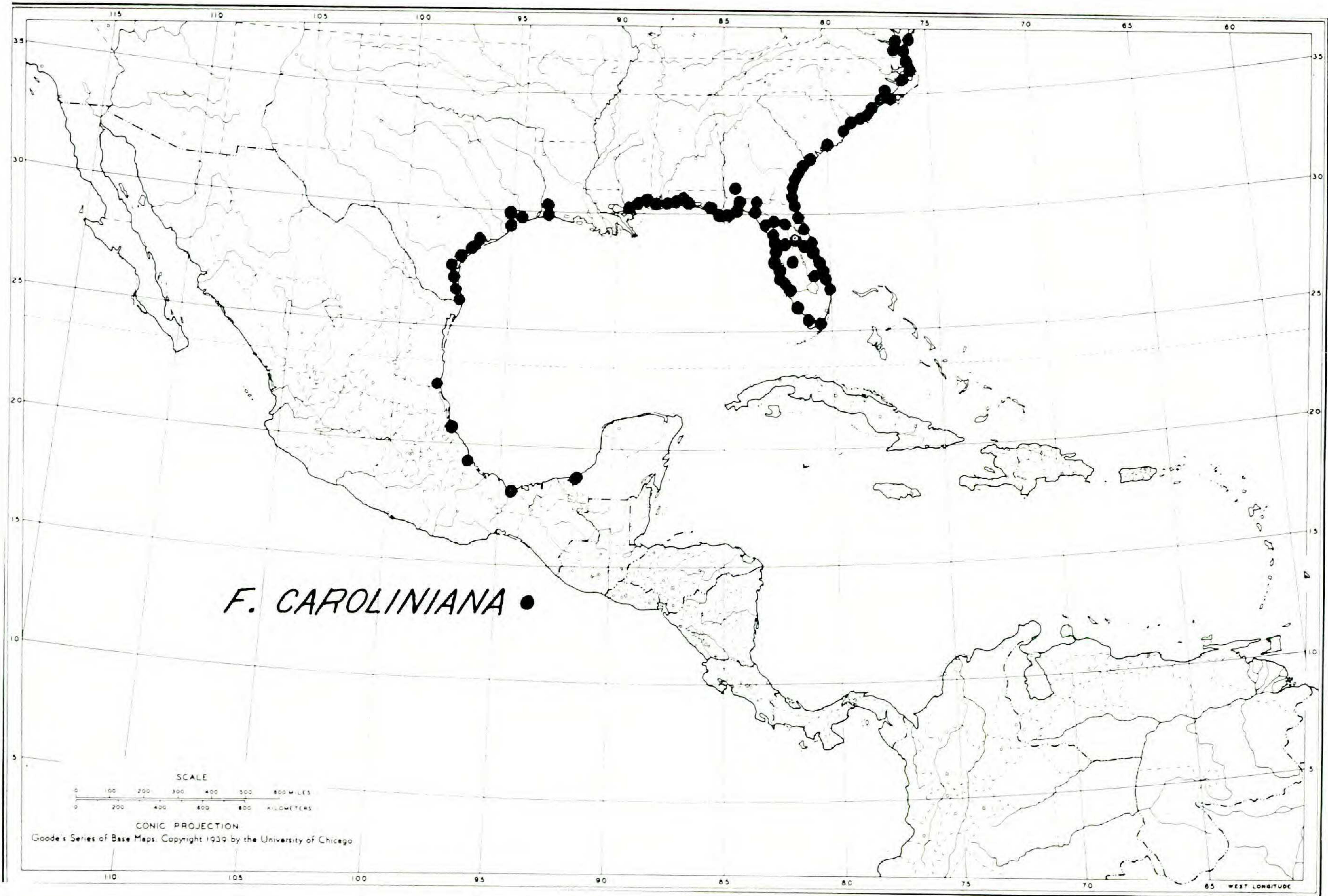


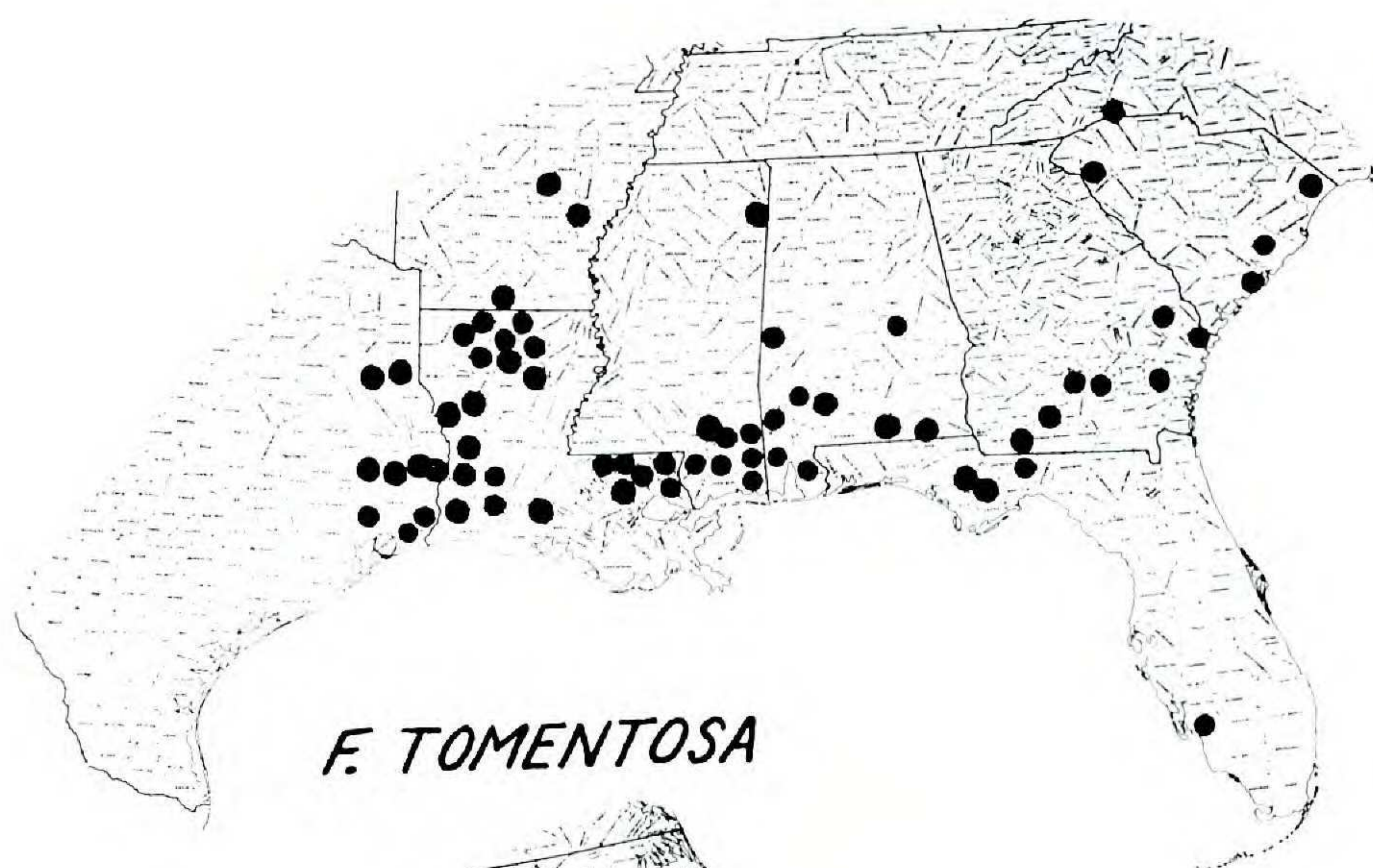




500 800 MILES
800 1200 KILOMETERS
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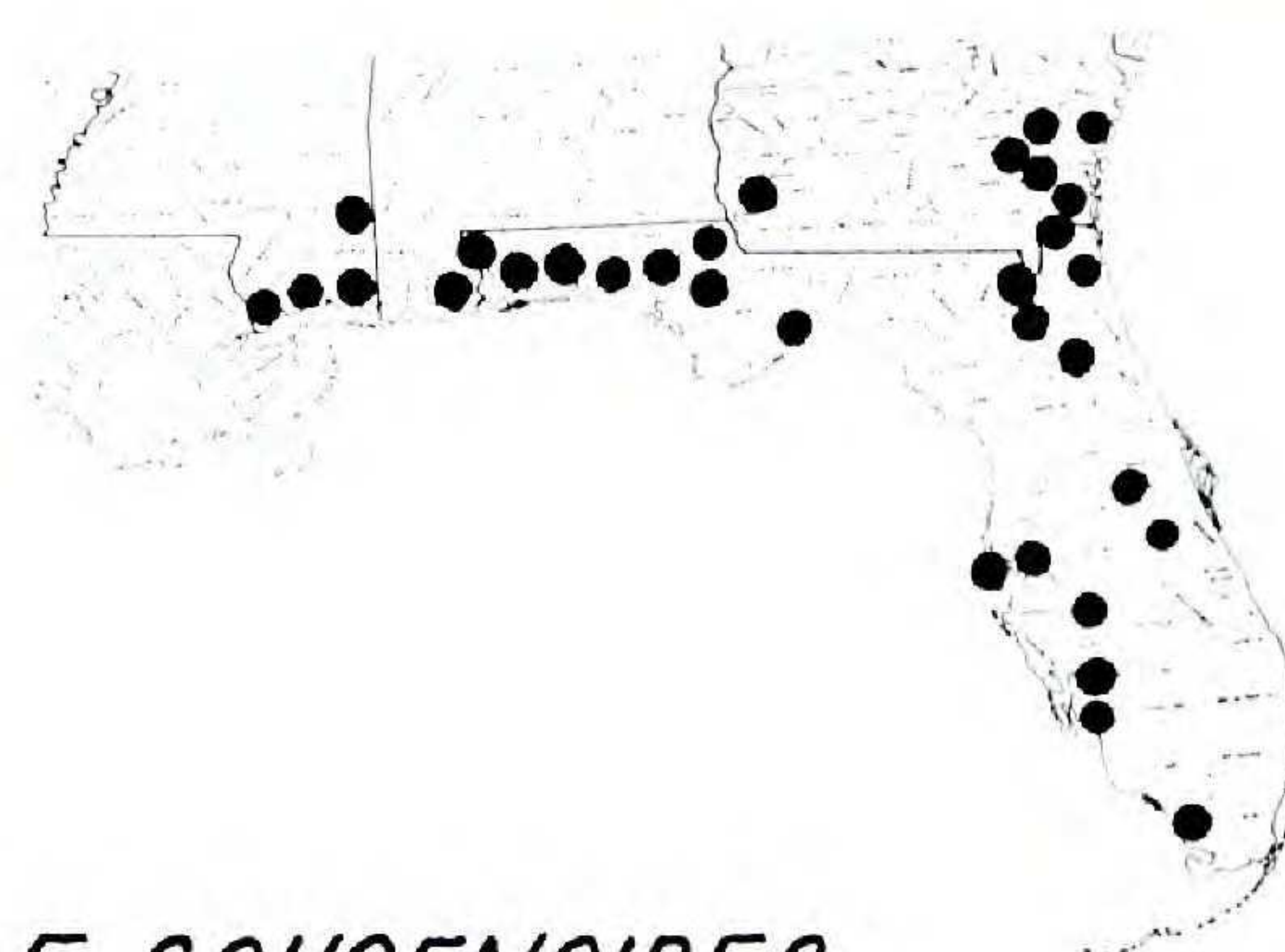




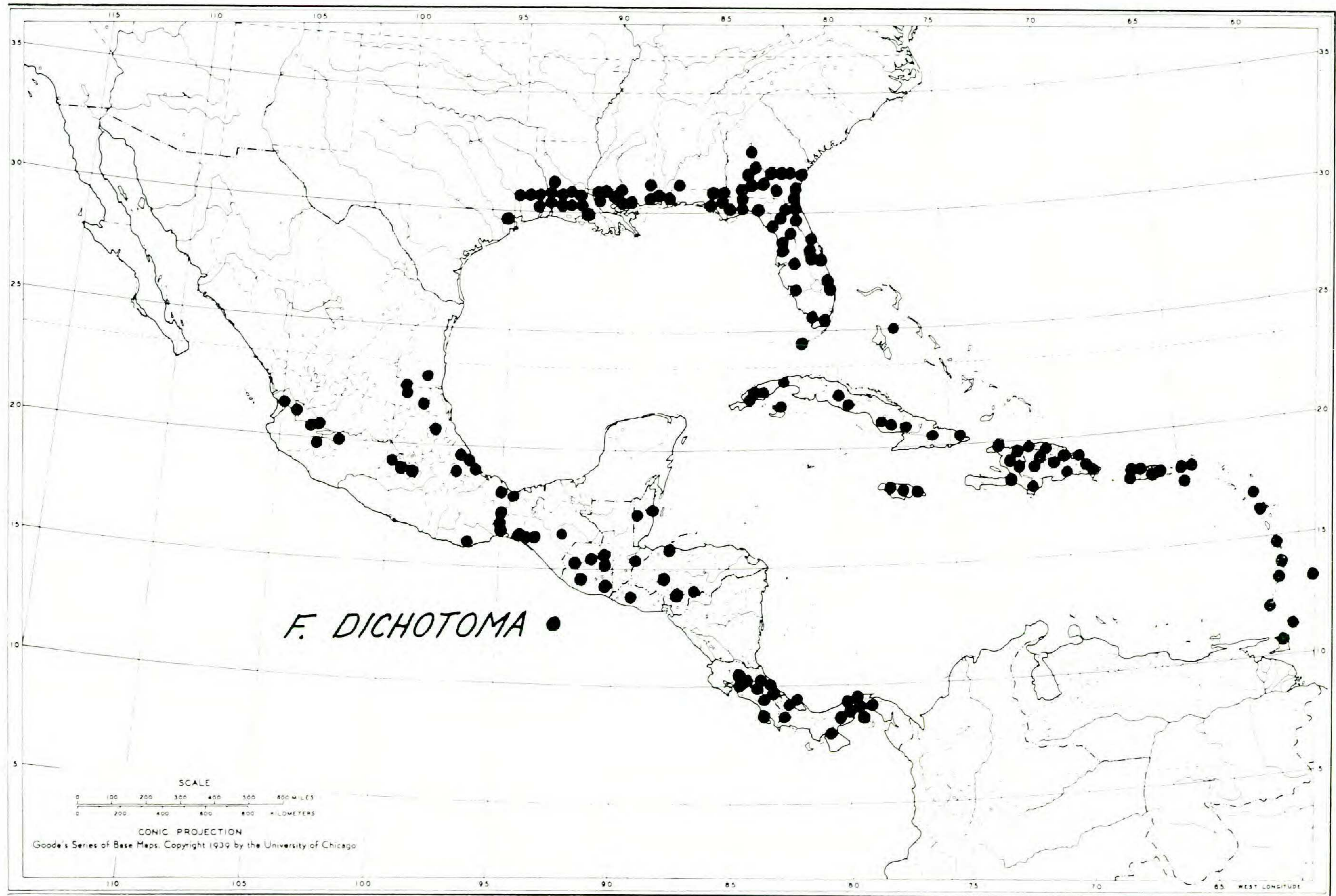
F. TOMENTOSA

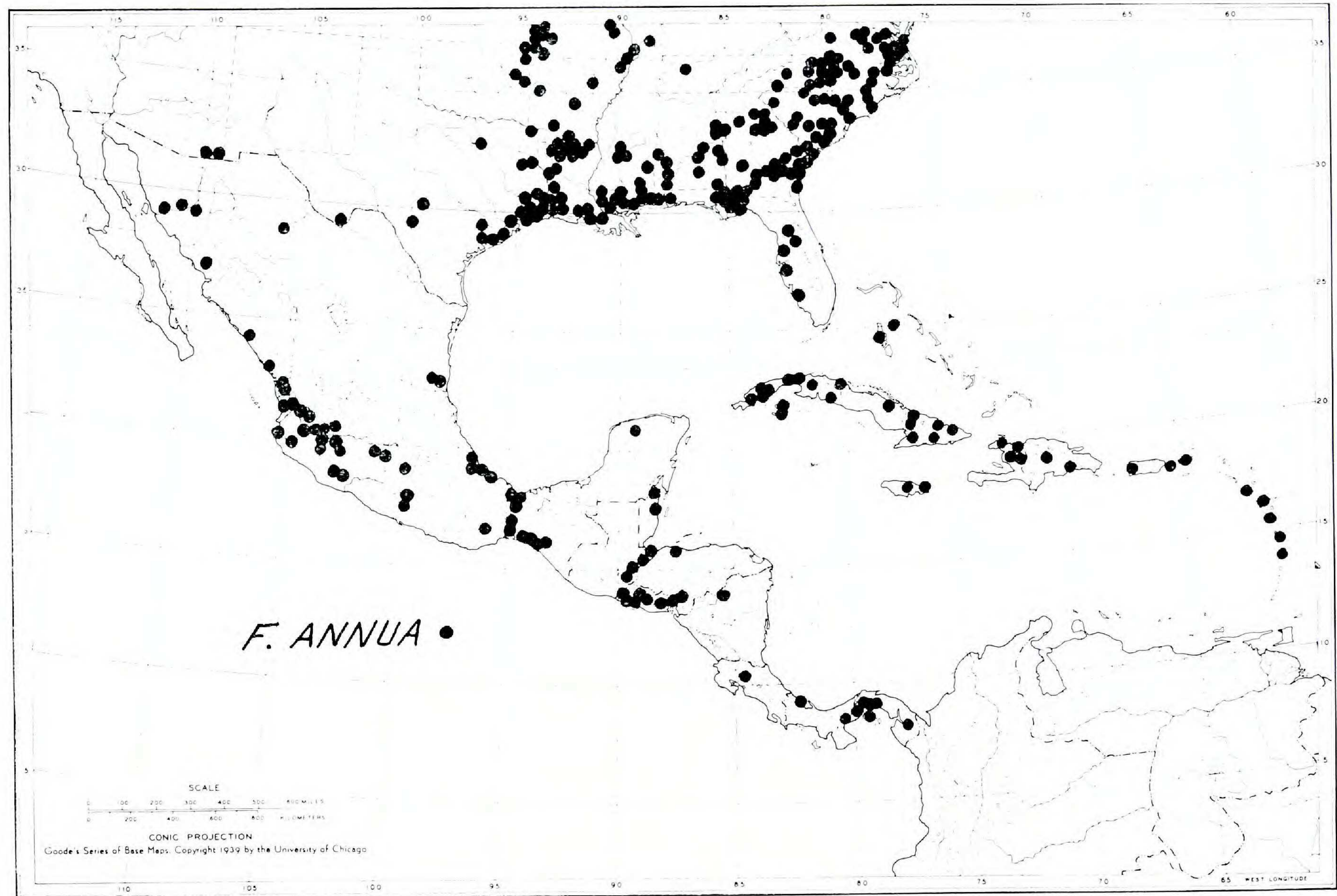


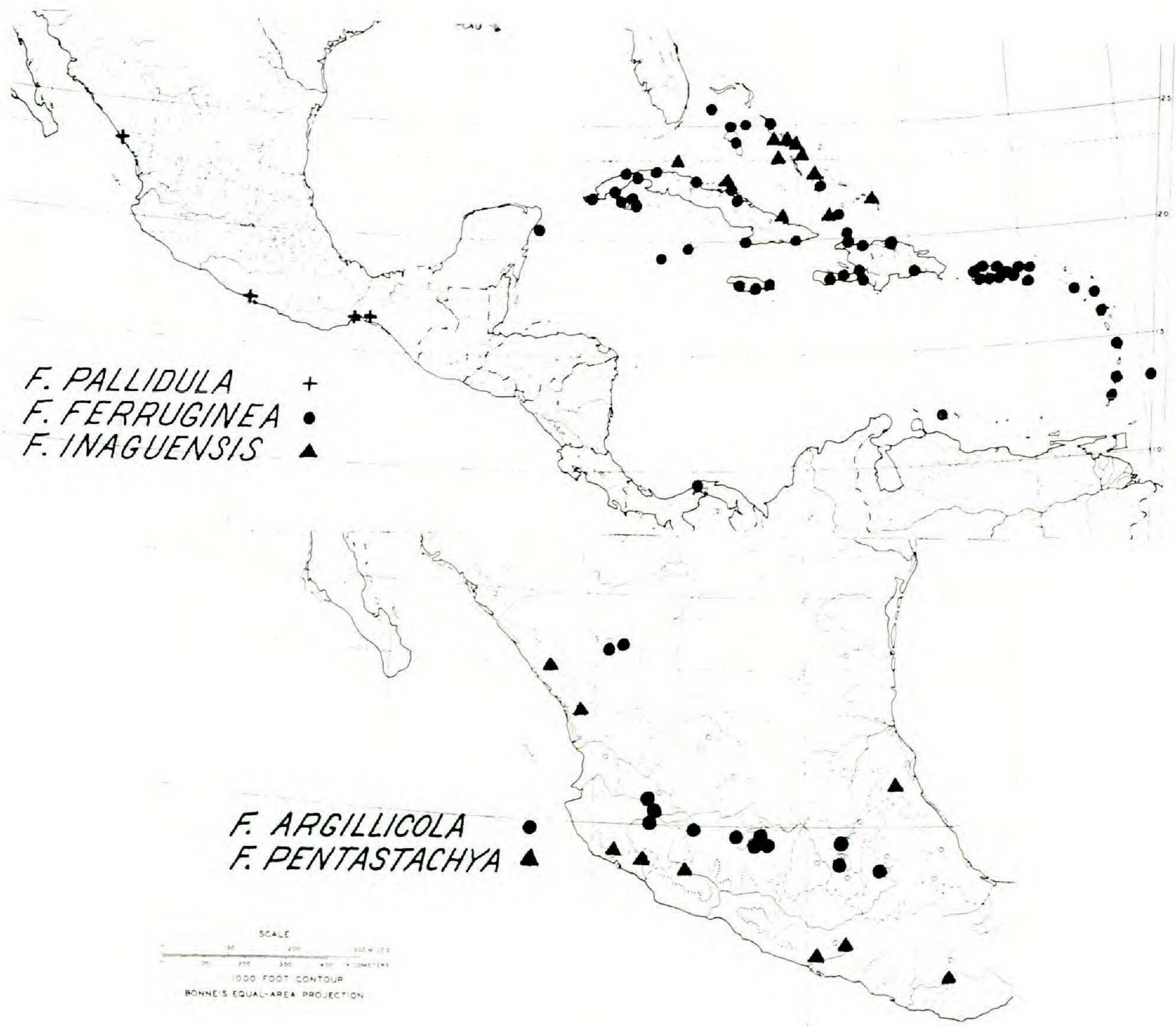
F. DECIPIENS

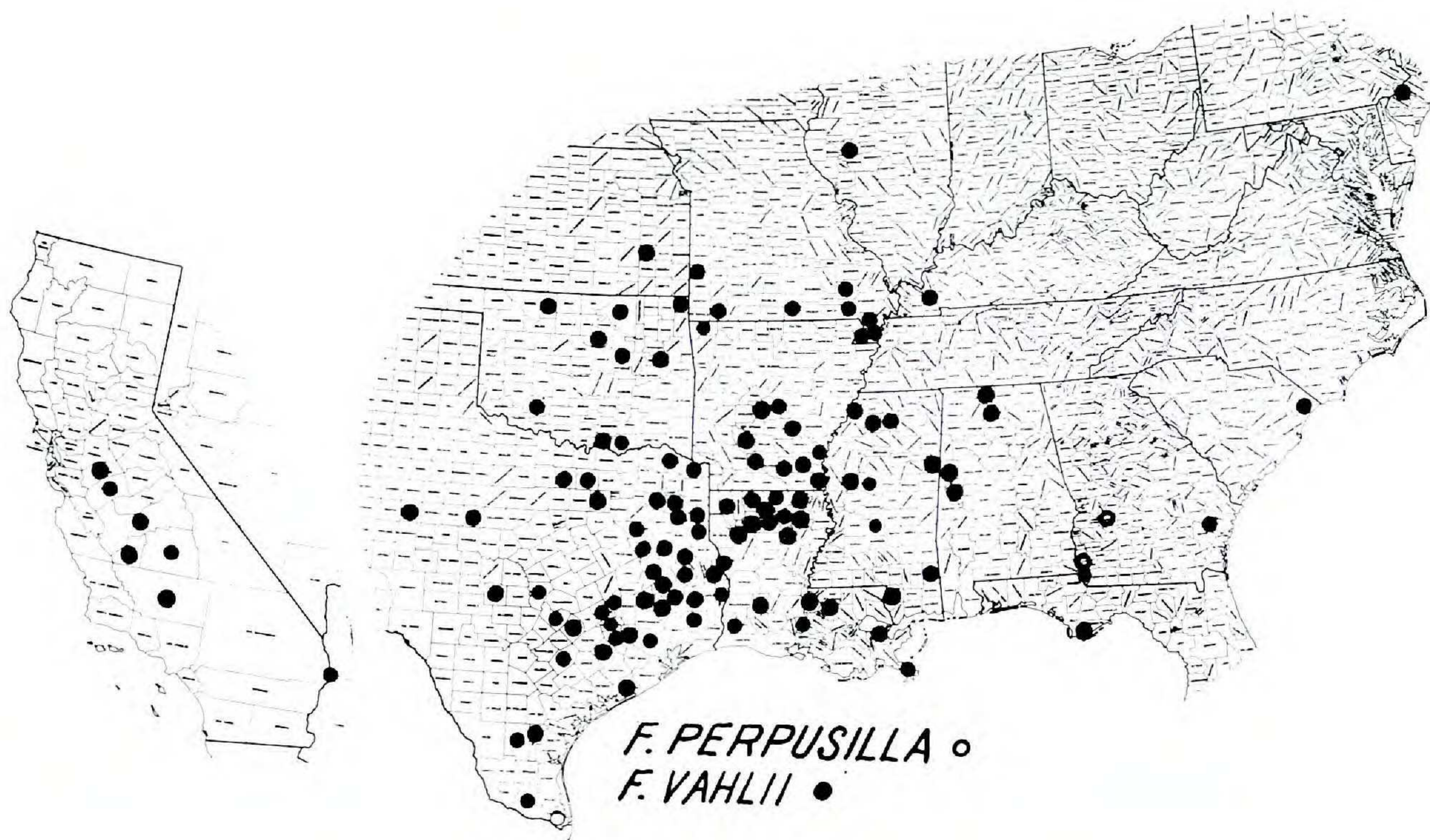


F. SCHOENOIDES

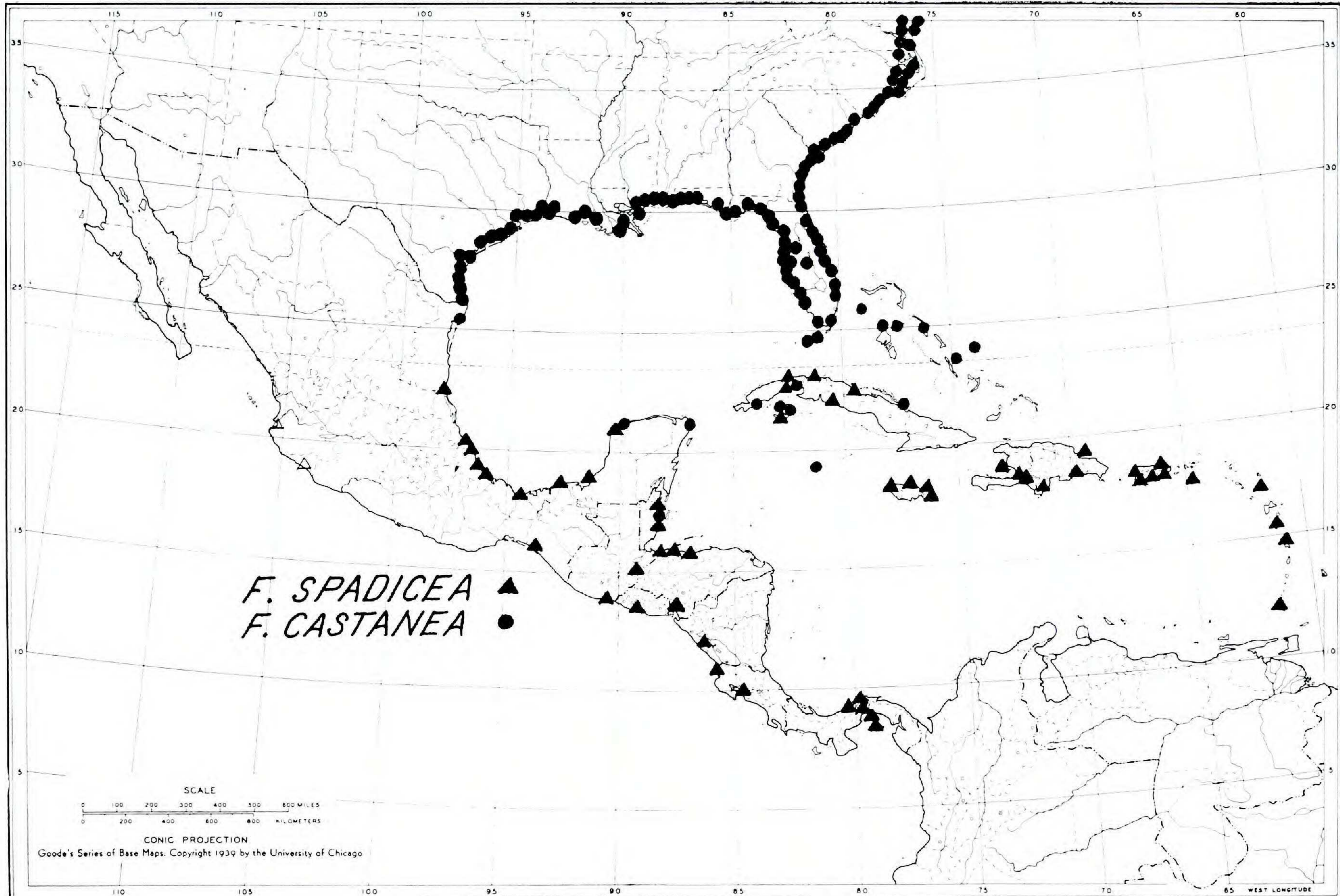


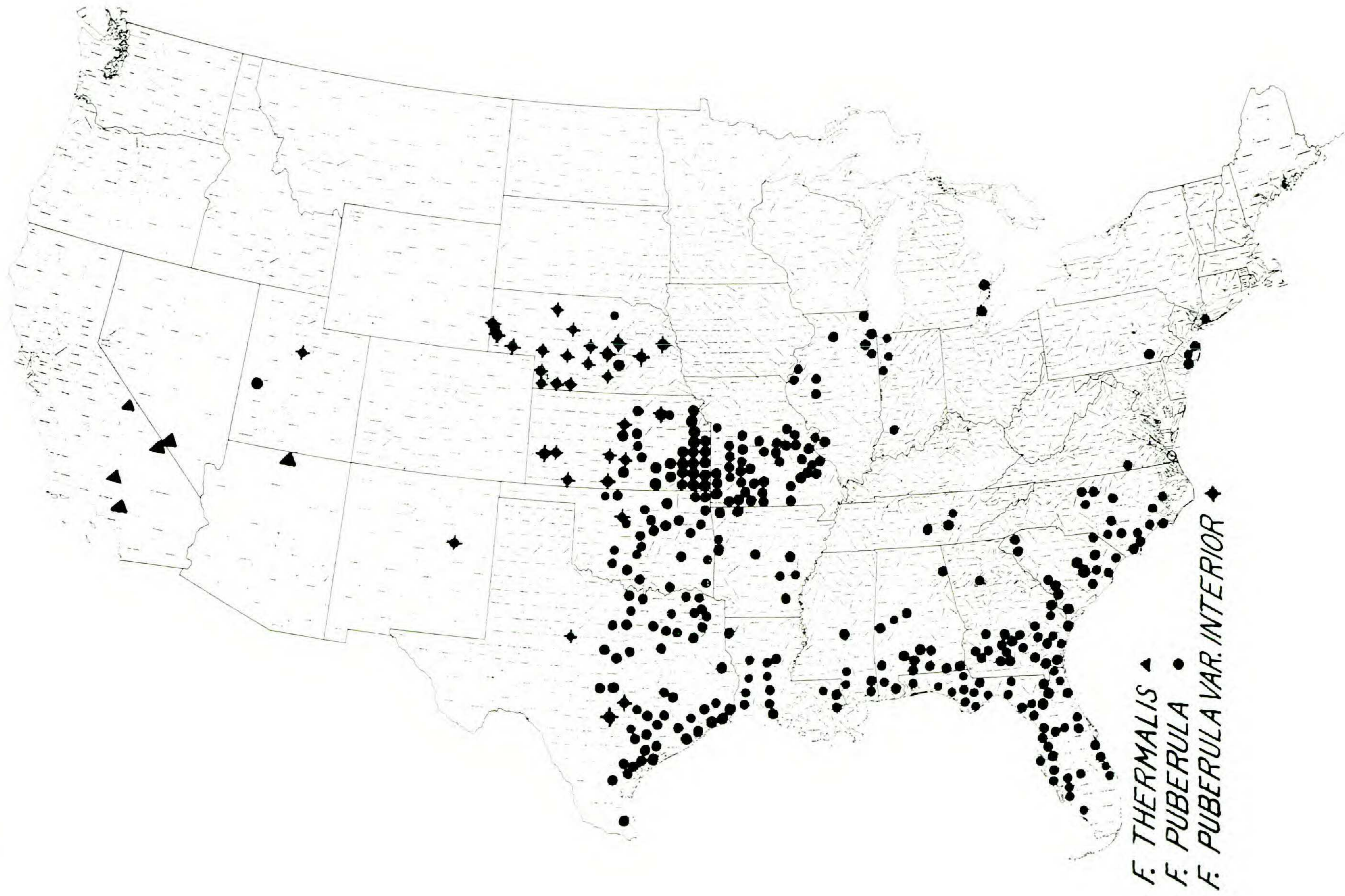












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